THE PLANT DISEASE REPORTER

Issued By

THE PLANT DISEASE SURVEY

Division of Mycology and Disease Survey

BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING

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The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Division of Mycology and Disease Survey serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

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DIVISION OF MYCOLOGY AND DISEASE SURVEY

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AN APPARENTLY NEW SWEET GUM DISEASE IN MARYLAND

Paul R. Miller and Muriel J. O'Brien

This preliminary report concerning what appears to be a new disease of sweet gum, Liquidambar styraciflua, is presented because of the potential seriousness of the trouble.

The senior author first became interested when he observed, about two years ago, that the sweet gum trees on his property in University Park, Prince Georges County, Maryland were exhibiting symptoms that had not previously been noted. A survey made in 1949 in University Park and its vicinity revealed that, of about 3,000 trees observed, 20 percent were showing various stages of decline. At present, the majority of the diseased trees originally observed have died, and approximately another 25 percent of the remaining trees are showing various stages of the disease.

It seems doubtful that this trouble could have been present for a long time and merely have been overlooked, since at the current rate of spread and death, sweet gum, which is abundant in this region, will soon be eliminated. Discussion with natives of the area does not indicate that this condition has been observed in former years, and there is no evidence that trees have been removed.

This disease is characterized by a dieback, starting at the periphery of the small branch tips and proceeding toward the main trunk (Fig. 1 - A and B). The leaves on diseased branches are usually much smaller than normal and become pigmented with anthocyanin by midsummer, when they are shed prematurely. In the next year the foliage tends to appear in bunches near the trunk and by midsummer the affected trees are dead.

Internal examination of a limited number of longitudinal sections of trees showed a streaking, ranging from amber color to deep brown, in the otherwise white, satiny sapwood of the lateral branches (Fig. 1, C & D). The heartwood exhibited the normal reddish-brown coloration. The roots of diseased trees have appeared healthy. No discoloration was observed in cross sections of the trunks near the ground line when the trees were removed.

Garren[1] recently reported what appeared to be a new disease of sweet gum in Alabama. However, his description differs materially from that of our condition in Maryland. He says, "This disease is definitely localized in the tree and does not develop throughout the perimeter of the crown as do most diebacks. It appears to be more prevalent and more destructive on younger trees where it usually begins in the terminal portion of the leaders. Thus, 'leader dieback' is an appropriate descriptive name." He describes internal symptoms associated with "leader dieback" as follows: "Inner bark and outer sapwood show streaks of blue-black to black discoloration extending downward beyond evident necrosis. Inner sapwood is normal, or with irregular, broken rings of light tan discoloration."

The distribution of affected trees in Maryland does not indicate any significant environmental relation. Sometimes the diseased trees occurred in groups, while in other cases they were more or less randomly distributed among healthy trees. Diseased trees were observed in open fields where they were growing in fertile, well-drained soil with no grading or other disturbance. There does appear, however, to be a much greater concentration of diseased trees in the area where they were first observed than in the rest of the community.

Attempts to isolate an organism[2] that might be responsible for this disease have given inconclusive results. Slivers of host tissue taken from various parts of diseased trees, including discolored areas of the sapwood, were surface-sterilized for varying lengths of time and plated out on malt, cornmeal, and potato dextrose agars. Plates were held at both room and 17° C. temperatures and examined after eight, fourteen and twenty-four days after plating. Fungi isolated, in order of frequency, from streaked portions of the wood were Diplodia, Trichoderma and Penicillium. One bacterium, determined by Dr. N. R. Smith as Bacillus pumilus Gottheil, was rather consistently obtained.

Although the staining color reaction technique developed by Lindner et al.[3] for the rapid detection of possible virus gave negative results, there is reason to believe that this disease is caused by a virus. This conjecture is based upon our inability to isolate an organism that would

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[1]Garren, Kenneth H. Leader dieback -- A "new" disease of Sweetgum. Plant Dis. Reptr. 33: 351-353. 1949.

[2]R. W. Davidson of the Division of Forest Pathology also made isolations with the same results. We are grateful for his cooperation.

[3]Lindner, R. C., H. C. Kirkpatrick, and T. E. Weeks. A simple staining technique for detecting virus diseases in some woody plants. Science n. s. 112: 119-120. 1950.

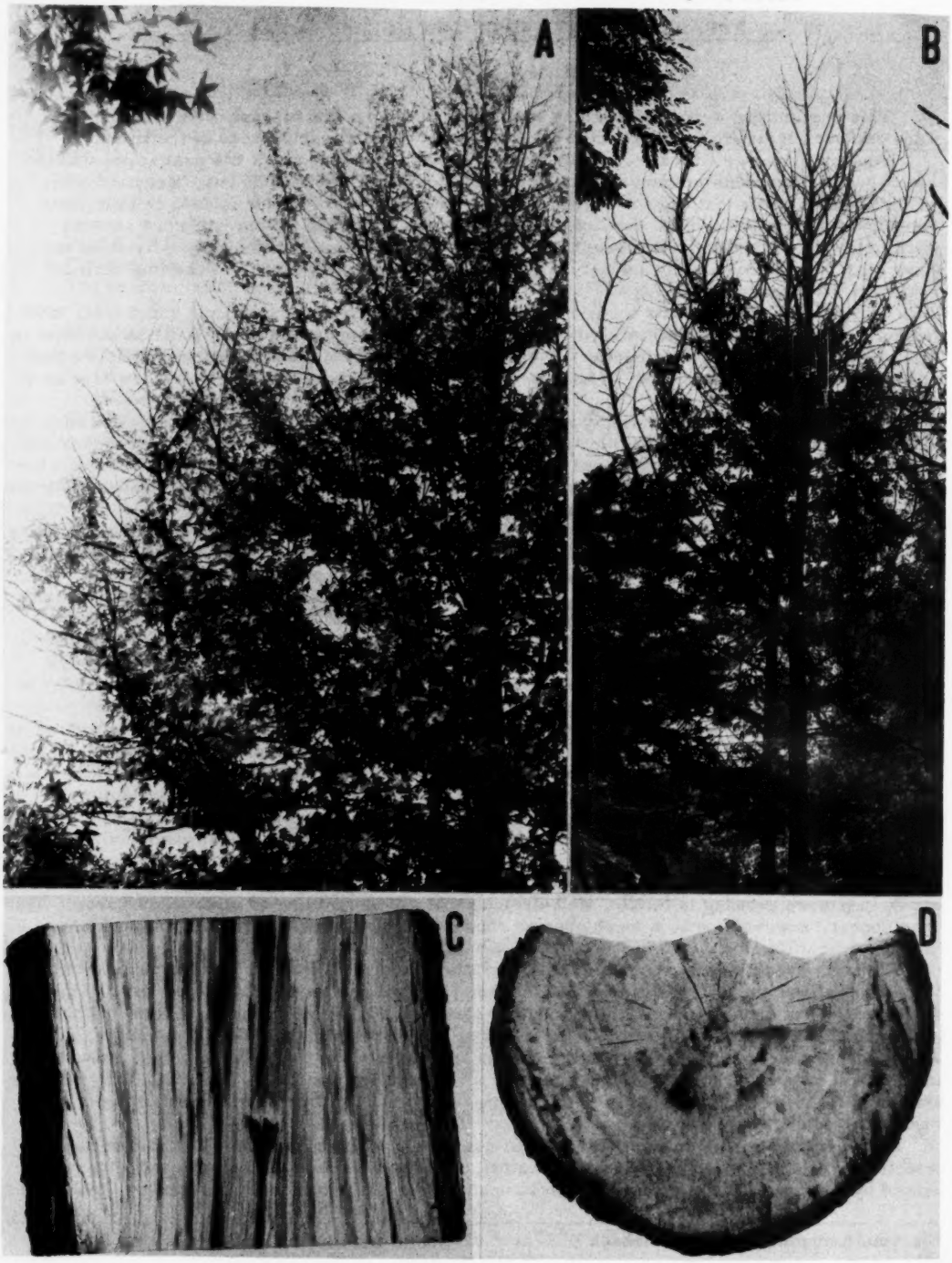

FIGURE 1. Undetermined Disease of Sweet Gum in Maryland: A. Diseased tree showing first noticeable symptoms. Note the small size or absence of leaves at the periphery of all small branch tips throughout the entire tree. B. Appearance of affected tree in second year after symptoms are first noticed. The foliage is confined to bunches along the main trunk. C. Longitudinal section of lateral branch showing sapwood streaking which ranges in color from amber to deep brown. D. Cross section of material shown in C.

seem to be responsible for the diseased condition, the symptom complex that is suggestive of virus diseases of woody plants, and the rapidity with which the individual trees die after the appearance of the first observable signs of trouble. Transmission studies are needed.

DIVISION OF MYCOLOGY AND DISEASE SURVEY

A PRELIMINARY REPORT ON THE PERITHECIAL STAGE OF CHALARA QUERCINA HENRY

T. W. Bretz

The perithecial stage of Chalara quercina Henry, the fungus that causes oak wilt, has been obtained in culture.

The first indication of perithecial development was observed in cultures of two isolates of C. quercina growing on media that contained as the only ingredient other than agar either finely ground chestnut "meats" or the water-soluble extracts from chestnuts. One of these isolates was obtained from a diseased Northern red oak (Quercus borealis) and the other from a diseased Chinese chestnut (Castanea mollissima). Perithecia-like structures were first observed 3 to 4 weeks after inoculation of culture flasks or tubes, which had been incubated at 25° C. They were few in number and upon microscopic examination proved to be nonfertile. They have remained so over a period of 3 months. When both isolates, however, were grown in the same culture dish on chestnut meal or chestnut infusion agar, fertile perithecia developed in considerable numbers, usually in a rather distinct zone where the colonies of the two isolates had grown together. Repeated pairing of these isolates in culture had consistently resulted in the production of fertile perithecia. Neither isolate, when grown alone on the same kinds of media, has ever produced fertile perithecia. This strongly suggests a condition of heterothallism.

To date the chestnut media have proved to be the most favorable for perithecial production. However, a few fertile perithecia have been obtained in pairing the isolates on sterilized twigs of Chinese chestnuts, American elm, and a Prunus species, and on potato dextrose agar.

The perithecia are minute, black, flask-shaped bodies, possessing a beak judged to be about as long as the diameter of the perithecial body. They grow singly, with the body almost wholly embedded in a dense felt of hyphae covering the substrate, with only the necks protruding above the level of the subiculum (Figure 1). They are, essentially, microscopic in size, but their presence in culture can be observed with the naked eye because of the extrusion of spores in a creamy-white, glistening mass at the mouth of the perithecial beak. The perithecial neck is terminated by a cluster or fringe of colorless cilia. The extruding spore mass is embedded in a sticky, gelatinous matrix, which is separated only with difficulty when immersed in water. The spores produced in the perithecia are readily distinguishable by microscopic examination from the endoconidia produced by C. quercina. They are unicellular, hyaline, elliptical in shape, and slightly curved on one face, not unlike the shape of the segments of an orange. In fresh, macerated mounts of the perithecia, the spores tend to adhere together, often in pairs. Six or more spores have been observed in groups not unlike the arrangement of the segments that make up an orange. These are thought to represent spore-bearing asci, although no well-defined ascus wall or membrane could be observed. It is believed that the asci are of an evanescent nature and that the ascospores are freed at maturity. In mounts of young perithecia, non-differentiated, sub-globose to ovoid cells, believed to be immature asci, have been observed.

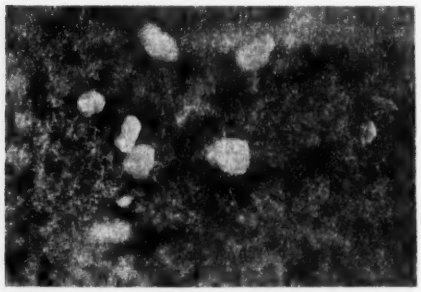

FIGURE 1. Masses of spores and matrix extruded from the necks of perithecia of Chalara quercina growing on agar (approximately x 15).

The connection between this perithecial stage and the asexual stage of Chalara quercina has been established by observing microscopically the germination of the ascospores and by making single-ascospore isolations. The germination of ascospores in 2 percent dextrose solution at 25° C, is rapid and at the end of 20 hours, the single germ tube produced is giving rise to characteristic C. quercina endoconidia. At this stage of germination the ascospore is still identifiable by shape. At the end of 30 to 48 hours in 2 percent dextrose solution at 25° C., the drops of solution are literally filled with the endoconidia produced by the germinating ascospores. Single-spore cultures, obtained by making dilutions of the ascospores on 2 percent agar and

subsequently transferring single sporelings to agar slants, have consistently given rise to typical C. quercina cultures. Of approximately 250 single-ascospore isolations to date, 88 percent have given rise to typical C. quercina cultures. In 12 percent of the cases the sporelings failed to continue their development or air contaminants developed in the tubes.

As far as is known, this is the first report of observation of the perithecial stage of the oak wilt fungus in culture; it is not known to have been observed in nature. Additional investigations on this stage in the life history of the fungus are in progress. A detailed description of the perfect stage of C. quercina and its identification will be published later in a technical journal.

DIVISION OF FOREST PATHOLOGY, BUREAU OF PLANT INDUSTRY, SOILS AND AGRICULTURAL ENGINEERING, U. S. DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE MISSOURI AGRICULTURAL EXPERIMENT STATION.

EXPERIMENTAL FORECAST OF WHEAT LEAF RUST IN OKLAHOMA FOR 1951 [1]

H. C. Young, Jr. and D. F. Wadsworth

This is the eleventh annual forecast of wheat leaf rust in Oklahoma. The previous ten forecasts have been made by Dr. K. Starr Chester, who originated the forecast, and the junior author. This, and subsequent forecasts, will be prepared in accordance with methods developed by Dr. Chester.

Excessive rainfall and mild temperatures during the summer of 1950 provided weather conditions suitable for over-summering of leaf rust on volunteer grain. Many early-planted fields became severely infected with leaf-rust in the fall. Death of considerable foliage led to a general reduction in vigor before winter temperatures arrested rust development. The severe drought of early winter, together with dry freezes in December and February, destroyed much of the wheat foliage, and most of the accompanying rust inoculum. However, scattered spots of early spring infection indicated that some rust was able to survive the winter as far north as Stillwater. Lack of moisture and sparseness of wheat foliage apparently were more important than temperatures in the destruction of rust inoculum.

Each year, sample collections of wheat plants from a susceptible variety are examined for rust pustules at 10-day intervals from February 1 through April 1. This year sample plants were obtained from a plot of Cheyenne wheat on the Agronomy Farm at Stillwater. The first count, made February 11, showed 170 pustules on 1000 tillers. By February 21 the count had risen to 375 pustules on 1000 tillers. During the last week in February a hard rain on the loose ground of the field buried many of the lower leaves on which the pustules had been found previously. Subsequent counts on March 3 and March 13 showed 160 and 130 pustules per 1000 tillers respectively. An infection period about March 15 raised the March 23 count to 390 pustules per 1000 tillers, but 10 days later the count had fallen, due to death of lower leaves, to 270 pustules per 1000 tillers. Thus the inoculum potential in the Stillwater area April 1 was somewhat lower than in 1950, but still considerably higher than in 1949.

On March 29-31, a 1554-mile survey was made through the principal Oklahoma wheat-growing areas, with fields sampled every 10 to 15 miles where possible. At only one point was there sufficient rust to warrant a severity rating. That area was in Logan County where readings varied from 0 to 1 percent in terms of the modified Cobb scale. Traces of rust were found in the following counties: Noble, Payne, Pottawatomie, McClain, Grady, Stephens, Jefferson, and Cotton. No rust pustules could be found in the following counties, all in the western half of Oklahoma: Tillman, Jackson, Kiowa, Washita, Custer, Dewey, Ellis, Cimarron, Texas, Beaver, Harper, Woods, Woodward, Blaine, Alfalfa, Kingfisher, Garfield, Grant, and Kay.

Although there were scattered fields in all sections of Oklahoma with heavy fall infections, the survey showed that no appreciable amount of rust survived the dry, rather mild winter.

The 1951 season promises to be one of below average rust development. The April 1 level of rust in the Stillwater area is higher than in 1949, but somewhat lower than in 1950, and other areas of the State are practically free of rust. One infection center in the Logan, Payne County area may develop, but even in that area damage is not expected to be severe.

While there may be considerable rust on the upper leaves by harvest time, the infections will be "too little and too late" to cause appreciable reduction in yield. Loss due to leaf-rust is not expected to exceed 2 to 3 percent, which is somewhat below average for Oklahoma. There should be more rust in the eastern areas of the wheat belt than in the central and western portions. Late crops and those in low, wet locations will suffer somewhat more damage.

OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE, STILLWATER

[1] Prepared for the June issue of the Reporter, but original copy lost in transit; hence the lateness of this forecast.

PHYSIOLOGIC RACES OF THE LEAF RUST OF WHEAT (PUCCINIA RUBIGO-VERA TRITICI) IN THE UNITED STATES IN 1950

C. O. Johnston and M. N. Levine[1]

Specimens of leaf rust collected on wheat were received from 214 localities in 30 States in 1950. These were analyzed for their physiologic race composition in the greenhouses at Manhattan, Kansas, and at St. Paul, Minnesota. Most of the collections from Minnesota, North Dakota, and South Dakota were tested at St. Paul. Collections from other States and some from the three foregoing States were cultured at Manhattan. The same techniques were used except that the full series of eight differential varieties were used at St. Paul, while only five differential varieties were used at Manhattan.

The results obtained are summarized in the Table (page 302). A total of 1,195 isolates yielded 33 physiologic races, but 18 of the races each comprised less than 1 percent of the total isolates identified and therefore cannot be considered to be important this year. Also some of these unimportant races are similar to others that were present in larger amounts. For example, race 2 is very similar to race 15; races 10, 20, and 31 are similar to race 9; race 52 is very much like race 5; race 6 is similar to race 105 and both of the latter are much like races 28, 40, and 126; race 7 is closely related to race 60, 17 to 93, and 58 to race 61; likewise races 35, 42, and 77 are closely related to race 21; while races 50 and 64 approximate race 49.

Only six of the races exceeded 5 percent of the total number of isolates. Race 5 was by far most abundant, representing 24.8 percent of all isolates, and appearing in collections from all but three States. Race 9 was next, comprising 19 percent of all isolates and occurring in all but eight States. It usually is prevalent in the Great Plains, South Central, and South Eastern areas. Race 126, the third most common, was isolated from collections from all but six States and constituted 16.2 percent of the total number of isolates. It has been increasing rapidly in recent years and has become one of the most important races in the hard red winter and hard red spring wheat areas. Race 15, which was very important in the eastern half of the United States some years ago, comprised 8.1 percent of the 1950 isolates. Race 58, making up 6.5 percent of the total number of isolates, is often important in the Ohio Valley, New England, and the Southeastern areas.

In addition to the six more prevalent races listed above, eight other races ranged from 1 to 4 percent of all isolates. Race 21, among these, is of considerable importance, more for its virulence than for the 3 percent prevalence. Race 11, as usual, proved to be most common in the Pacific Coast States. Race 93 was fairly abundant in southeastern collections but seldom was encountered elsewhere.

Collections from Minnesota yielded the greatest number of races followed by those from South Dakota and North Dakota. Among the collections analyzed at Manhattan, Kansas, ten races isolated from Idaho collections were the greatest number obtained; nine races were obtained from Kansas collections; and eight from collections made in Florida, Georgia, Mississippi, and Nebraska.

COOPERATIVE INVESTIGATIONS BETWEEN THE DIVISION OF CEREAL CROPS AND DISEASES, BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING, AGRICULTURAL RESEARCH ADMINISTRATION, UNITED STATES DEPARTMENT OF AGRICULTURE, AND THE KANSAS AND MINNESOTA AGRICULTURAL EXPERIMENT STATIONS.

[1]Various people have given assistance by sending rust collections for which the writers express their appreciation.

Table 1. Physiologic races of Puccinia rubigo-vera tritici isolated from leaf-rust infected wheat specimens collected in 30 States of the United States between Jan. 1 and Dec. 31, 1950.

State	Frequency distribution of physiologic races isolated																															Total Isolates	No. Races
	1	2	4	5	6	7	9	10	11	15	17	20	21	28	31	33	35	40	42	49	50	52	56	58	60	61	64	77	90	91	93	105	126		
Ala.	-	-	-	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	5	3
Ark.	-	-	-	6	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	9	21	4
Calif.	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1
Colo.	-	-	-	6	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	15	3
Fla.	-	-	-	15	-	-	29	-	1	6	-	-	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	7	6	68	8
Ga.	-	-	-	6	-	-	5	-	-	4	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	9	1	18	45	8
Idaho	1	-	-	4	-	-	2	-	2	1	-	1	-	-	-	-	-	-	-	-	3	-	-	1	-	-	-	-	-	-	1	1	17	10
Ill.	-	-	-	6	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	7	17	5
Iowa	-	-	-	8	-	-	3	-	-	5	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	3	7	25	6
Kans.	-	-	-	78	-	-	68	-	-	15	-	-	16	-	-	-	-	-	-	-	7	-	-	10	-	-	-	-	-	2	23	31	250	9
Ky.	-	-	-	4	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	2	12	7
Mich.	-	-	-	12	-	-	1	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	4	7	35	6
Minn.	1	6	1	18	7	3	8	1	1	6	-	-	4	7	3	-	11	3	2	-	-	12	1	1	3	2	-	6	1	-	-	4	42	155	26
Miss.	-	-	-	4	-	-	3	-	-	5	-	-	1	-	-	-	-	-	-	-	2	-	-	1	-	-	-	-	-	1	2	13	31	8
Mo.	-	-	-	3	-	-	1	-	-	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	3	17	6
Nebr.	-	-	-	42	-	-	47	1	-	17	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	17	136	8
N.Y.	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	4	-	13	3
N.C.	-	-	-	1	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	1	-	1	14	5
N. Dak.	-	1	-	13	2	-	7	1	1	5	-	-	-	1	-	-	8	1	-	1	-	8	-	3	-	1	-	-	-	-	8	5	60	16
Ohio	-	-	-	4	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	1	2	14	5
Okla.	-	-	-	17	-	-	6	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	7	34	6
Pa.	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	1	6	3
S.C.	-	-	-	13	-	-	5	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	-	1	29	7
S. Dak.	-	8	-	11	3	-	4	2	-	10	2	-	2	2	2	1	4	1	-	-	-	5	1	4	-	1	1	4	-	-	-	3	4	75	21
Tex.	-	-	-	10	-	-	18	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	2	2	43	6
Va.	-	-	-	3	-	-	-	-	-	1	-	-	5	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	2	18	5
Wash.	-	-	-	1	-	-	-	-	7	-	-	1	-	-	-	-	-	-	-	-	2	-	-	2	-	-	2	-	-	-	-	2	17	7
W. Va.	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	4	3
Wis.	-	-	-	4	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	1	4	13	5
Wyo.	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	3	3
No. times isolated	2	15	1	236	12	3	227	6	15	97	2	6	36	10	5	1	17	5	2	1	16	25	2	78	3	4	3	10	1	1	14	85	194	1195	-
Pct. total isolates	0.2	1.3	0.1	24.8	1.0	0.3	19.0	0.5	1.3	8.1	0.2	0.5	3.0	0.8	0.4	0.1	1.4	0.4	0.2	0.1	1.3	2.1	0.2	6.5	0.3	0.3	0.3	0.8	0.1	0.1	1.2	7.1	16.2	-	-

REACTION OF COWPEA VARIETIES TO BACTERIAL CANKER

Helen S. Sherwin and C. L. Lefebvre

Bacterial canker of cowpeas came to the attention of the writers in the summer of 1944 when diseased specimens of the variety Blackeye, collected by P. A. Young in Cherokee County, Texas, were sent to us for identification. Dunlap (4) in 1943 first reported this disease and sent specimens to Burkholder (3), who in 1944 described the bacterial pathogen as a new species, Xanthomonas vignicola. Simultaneously with Burkholder's report, Hoffmaster (6) published a note on the bacterial canker disease in Oklahoma and suggested that it was caused by Bacterium vignae Gardner & Kendrick (5), an organism known to cause a leafspot of cowpeas and lima beans. Other investigators reported severe damage from the disease. Larsh (8) in 1943 reported a loss from the disease at Perkins, Oklahoma, estimated at nearly 4 percent, and again in 1944 (9) he found two diseased fields, the more seriously affected being near Cleveland, Oklahoma, where 5 percent of the plants in one field were attacked. Sixty percent of the plants of California Blackeye were killed at Winter Haven, Texas in 1943, according to Watkins (12).

What appears to be the bacterial canker organism, Xanthomonas vignicola, was reported from Kansas (13) [here called Phytomonas vignae], where it completely destroyed the seedlings of certain varieties of cowpeas. The varieties damaged least were Brabham, Groit, New Era, and Victor, varieties that are known to have some resistance to the bacterial canker organism.

After these investigations were started, there were further reports of the disease. In 1945, the writers (10) reported on some preliminary inoculation tests with the bacterial canker organism. Boewe (2) found the disease for the first time in Illinois, where 5 percent of the plants were infected in a six-acre planting consisting of a mixture of New Era, Red Ripper, and Whippoorwill varieties. In 1949, Preston (11) published his observations on the disease and results of inoculation tests in Oklahoma, where widespread damage to some of the best adapted varieties occurred.

ISOLATION OF THE CAUSAL ORGANISM

First attempts to isolate the causal organism from the Texas specimens resulted in the appearance of both white and yellow colonies in the plates. However, inoculation of several cowpea varieties with organisms from both types of colonies established the fact that only the bacterium from the yellow colonies was pathogenic. When infected portions of cowpea plants, collected later at Gainesville and Quincy, Florida, were plated out, an organism producing yellow colonies, similar to that isolated from the Texas specimen, was found in both cases. When these organisms were grown on differential media, their response was such that they could be identified as Xanthomonas vignicola.

METHODS OF INOCULATION AND SYMPTOMS PRODUCED

Several techniques were tested to find which would produce the most severe and consistent infection in inoculated plants. Since method of inoculation affected kind of symptom obtained, each method will be discussed separately. Unless otherwise stated, inoculation tests were conducted in a greenhouse at about 27° C. The cultures of X. vignicola, obtained from the sources previously mentioned, consistently produced typical symptoms on susceptible plants of cowpea in preliminary tests.

Germinated seed inoculations. -- Following the method suggested by Jensen and Goss (7), sprouted seeds were immersed for two hours in a concentrated suspension of the bacterial canker organism in water. The first symptoms of infection occurred on the primary leaves six or seven days after inoculation and consisted of small whitish spots about 1 mm. in diameter. Lesions on leaves of the varieties Blackeye and Chinese Red are illustrated in Figure 1. The lesions soon enlarged to about 1 cm. in diameter and a brown necrotic center developed that later fell out, producing a "shot-hole" effect encircled by a halo. Two weeks later, some of the lesions were 2 cm. or more in diameter. Severely infected leaves wilted and dropped. Cankers developed on the stems at the base of wilted leaves, at the gound level, or at various other places along the stems. Sometimes yellowish-green, water-soaked lesions on leaves were the first sign of infection; at other times yellowish infected areas developed along the edges of leaves, causing them to stop expanding at that point. Lesions varied greatly in size and number, sometimes coalescing and covering most of the leaf blade.

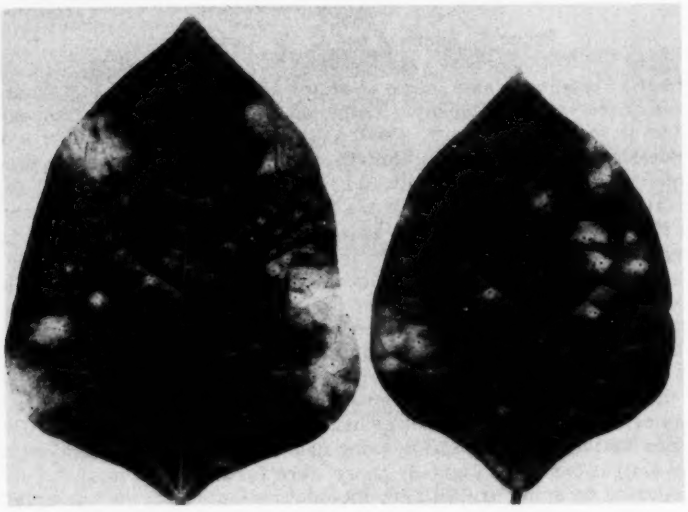

FIGURE 1. Leaf of Chinese Red cowpea (left) and leaf of Blackeye cowpea (right), inoculated with Xanthomonas vignicola by spraying with an aqueous suspension. Photo taken 19 days after inoculation.

Infected plants were often stunted and their trifoliolate leaves were dwarfed. Cankers spread rapidly in susceptible plants and often covered the entire length of the stem. Many plants with deep, broad, open cankers broke and fell over; however, some stunted plants with deep cankers survived and produced a few pods. The seed produced on these infected plants might possibly carry the bacterial canker organism.

Leaf inoculations by spraying. -- The plants were sprayed with a bacterial suspension in water, usually at the stage when the second or third trifoliolate leaves had just unfolded. In some cases they were placed in a moist chamber overnight before inoculation; in others they were inoculated immediately after placing in the moist chamber, but in both cases they were incubated approximately 16 hours following spraying.

Leaf lesions similar to those described and illustrated in Figure 1 were observed. Wilting of the primary and trifoliolate leaves became pronounced about three weeks following inoculation. Cankers sometimes developed and some of the plants eventually died.

Multiple needle, primary leaf inoculations. -- When primary leaves of cowpeas were inoculated by the multiple needle method of Andrus (1) they wilted and chlorotic, straw-colored areas developed within the needle-puncture area six days after inoculation. Susceptible varieties sometimes were more severely wilted and had more chlorotic or straw-colored tissue in the needle-puncture area and more tissue breakdown beyond the inoculated area than the resistant varieties. However, these results were not consistent and it was difficult to distinguish resistant plants in a segregating population under the conditions of this experiment. Moreover, it required 21 days for severe cankers to develop on stems of susceptible plants inoculated by this method in contrast to 14 to 17 days for plants inoculated by the stem-stabbing method.

Pod inoculations. - Pods in several stages of development were inoculated by puncturing twice with an arrow-point needle through a bacterial smear, along the line of one of the sutures.

Symptoms of infection were: arrested growth at the point of inoculation, failure of the seeds to develop in that part of the pod, cracking and splitting along the suture where the stab was made, presence of bacterial slime in the wound, and water-soaking of the stunted area surrounding the fissure. Pods inoculated when immature shriveled and dropped off before the seeds developed.

Root inoculations. -- Seedlings of cowpeas grown in sand were inoculated when the trifoliolate leaves unfolded. The seedlings were removed from the sand, inoculated by cutting the tips of the roots under a bacterial suspension, and then transplanted to 4-inch pots of soil.

Typical cankers and leaf symptoms appeared on the susceptible varieties about three weeks after inoculation.

Stem inoculations by rubbing with carborundum powder. -- Stems of cowpea seedlings were rubbed lightly just below the primary leaves with a mixture of a concentrated bacterial suspension and carborundum powder.

With this method, two weeks were frequently required before any sign of cankers or leaf symptoms appeared; however, some plants of susceptible varieties ultimately succumbed to infection.

Stem inoculations by stabbing. -- The stems were stabbed twice with an arrow-point needle through a bacterial smear placed on the stem about one-half inch below the primary leaves. Inoculations were made when the first trifoliolate leaves were beginning to unfold.

Several days after inoculation, the area surrounding the punctures became chlorotic, swollen, and blistered; ultimately these blisters ruptured and an open canker formed. A similar chlorotic, swollen, and blistered streak appeared above and below the stab when the bacteria multiplied and spread along the stem. Later the tissue forming the streak turned tan to brown, dried, and finally cracked. The wound enlarged along this line and an open canker was formed which sometimes extended the entire length of the stem, and was frequently so severe that the stem became flattened. Such cankers were present on susceptible varieties 14 to 17 days after inoculation. Different degrees of canker formation in susceptible varieties are shown in Figure 2.

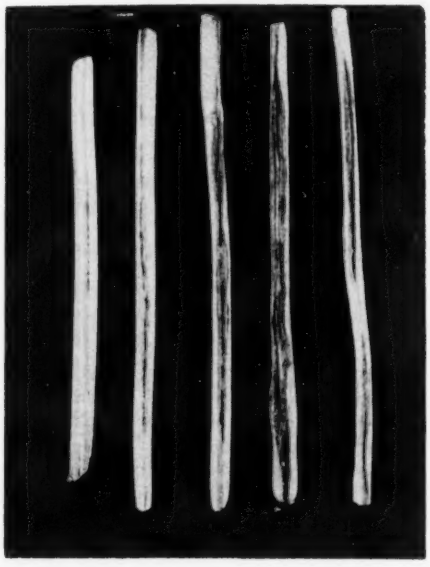

FIGURE 2. Progressive stages of canker formation on stems of susceptible cowpea varieties infected with Xanthomonas vignicola.

These large, open cankers often became avenues of entrance for other organisms. As the canker enlarged, the bacteria reached the petiole of the primary leaf and caused darkening and water-soaking of the petiole and subsequent wilting of the leaf. Generally, no distinct lesions appeared on the wilted leaves; however, irregular, yellowish, water-soaked areas a few millimeters to several centimeters in diameter occasionally developed before the leaves wilted. The type of lesion found most frequently on the leaves was spherical, a few millimeters to about one centimeter in diameter, yellowish and water-soaked with a necrotic center one to several millimeters in diameter. When a plant was severely infected, the trifoliolate leaves were smaller than normal and wilted as soon as they began to unfold. Often, when the terminal growth was killed, lateral branches developed below the canker. Plants of a susceptible variety inoculated by the stem-stabbing method are shown in Figure 3.

Stem cankers and typical leaf lesions rarely developed on plants of highly resistant varieties. These varieties usually reacted to the stab inoculations in one of two ways: (1) by a slight swelling of the tissue around the stab, or (2) by a slight collapsing and darkening of the tissue and formation of short, dark, purplish-brown streaks a few millimeters to several centimeters in length above and below the point of inoculation. Moderately susceptible plants, such as those of the variety Groit, sometimes developed small cankers at the point of inoculation, or narrow purplish-brown streaks up to two inches long above and below the stab, and a few typical leaf symptoms. Cankers which eventually killed the plant were rarely produced, but if such cankers formed, they were never as large as those on susceptible varieties, nor was the killing as rapid.

FIGURE 3. Whippoorwill cowpeas inoculated with Xanthomonas vignicola by the stem-puncturing method. A different culture was used for each of the three pots and, as indicated in the photograph, the three cultures varied in pathogenicity.

The stem-stabbing method was adopted for testing large populations because it consistently produced severe symptoms in the shortest time.

REACTION OF COWPEA VARIETIES TO XANTHOMONAS PHASEOLI

Burkholder (3) showed that X. vignicola was distinct from X. phaseoli, the common bean blight organism. Additional evidence that these two organisms were different was obtained by inoculating 20 of the commonly-grown cowpea varieties [1] and Red Kidney bean with X. phaseoli by the stem-stabbing method. None of the cowpea varieties were susceptible to X. phaseoli but some produced a noticeable reaction to the stabbing. A reddish-brown discoloration, which extended in a narrow streak about two inches above and below the point of inoculation, developed in inoculated plants of the variety Groit. From this streak the organism was readily isolated. Some plants of the variety New Era developed small cracks or atypical cankers at the point of inoculation, while the varieties Early Buff and Whippoorwill reacted to the stabbing by producing a slight swelling at the point of inoculation. No noticeable reaction to infection developed in other varieties of cowpea. All inoculated plants of Red Kidney bean developed typical symptoms of the common bacterial blight disease.

REACTION OF COWPEA VARIETIES TO XANTHOMONAS VIGNICOLA

The reaction of plants from 351 seed lots of cowpeas and beans to the bacterial canker disease was determined. The stem-puncturing method was employed. Hosts inoculated included most of the commonly grown varieties of Vigna sinensis, some hybrid selections, a group of numbered introductions which have not been identified as to variety, a number of wild or exotic species including V. catjang, V. cylindrica, V. repens, V. sesquipedalis, V. triloba, V. vexillata, V. wilmsii and some unidentified Vigna spp. Also, several species of related genera were tested, including Dolichos biflorus, D. lablab, Otoptera burchellii, Phaseolus sp., P. lunatus and P. vulgaris.

In Table 1 are shown the disease ratings of all varieties and species tested. The following

[1] Blackeye, Brabham, Browning, Calva, Calva No. 6, Catjang Buff, Chinese Red, Conch, Early Buff, Early Red, Early Silver Crowder, Groit, Honolulu, Iron, New Era, Potomac, Progressive White, Taylor, Victor, Whippoorwill.

V. sinensis introductions, selections, and varieties were immune or highly resistant: P.I. Nos. 152,199, 167,284, and 186,456; Beltsville No. 301; "Azul Grande" (a selection from New Era x Sugar Crowder); Brabham; Buff; Iron; Six-weeks - Ala. (SCP No. 9); Suwannee; and Victor. Also in this category were: Dolichos lablab; Otoptera burchellii; Phaseolus lunatus (Fordhook lima - Regular, and Henderson Bush Lima); X. Phaseolus sp.; Vigna spp. (P.I. Nos. 158,831, 171,985, 182,025, and Beltsville Nos. 300, 302, 304, and 305); V. cylindrica (P.I. 124,606); V. repens; V. sesquipedalis (Beltsville Nos. 127 and 128); V. triloba (P.I. 181,584); and V. vexillata (P.I. 159,210). In the moderately resistant class were the following V. sinensis introductions, selections, and varieties: P.I. Nos. 121,430, 121,433, 147,076, 147,077, 147,078, 147,561, 148,674, 151,555, 152,194, 152,195, 152,196, 152,197, 152,198 and 186,386; Beltsville No. 88; "Chinito" (a selection from Yardlong x cowpea crossed with "Azul Grande"); Conch; Crowder (Brown); Michigan Favorite; Nassau; and New Era. Dolichos biflorus; P. vulgaris (Tenn. Green Pod); and V. vexillata (P.I. 159,212) were also in this class. The following V. sinensis introductions, selections, and varieties were rated as moderately susceptible; P.I. Nos. 147,559, 147,562, 147,563, 154,133, 162,924, 162,925, 165,443, 171,066 and 183,089; "Chinegro" (a selection from Yardlong x cowpea); "Garbancito" (a selection from New Era x Sugar Crowder); Alabunch; Black; Blue Goose; Brown Crowder (Jackson 21, SCP No. 7); Cream Crowder; Cream Crowder (selection); Crowder, L-sp.; Red Speckled Crowder; and Speckled Crowder; Groit; and Holstein (almost black). P. vulgaris (Red Kidney Bean); and V. wilmsii (P.I. 181,585) were also in this class. All other introductions, selections, and varieties of V. sinensis and related species and genera that were tested were considered susceptible.

Table 1. Reaction of varieties of Vigna sinensis and related species and genera to Xanthomonas vignicola.

Beltsville no.	Variety or description and source	Disease rating[a]	Beltsville no.	Variety or description and source	Disease rating
148	Alabrowneye, Auburn, Ala.	9+	169	Blue Goose or Grey Speckled Crowder, SCP No. 8, Charleston, S. C.	8
149	Alabunch, Auburn, Ala.	6			
150	Alacrowder, Auburn, Ala.	10			
151	Alalong, Auburn, Ala.	8	61	Blue Goose, Stillwater, Okla.	7
35	Arlington, Beltsville, Md.	10	10	Brabham, Beltsville, Md.	0
23	Blackeye, Beltsville, Md.	10	82	Brabham, K892, Stillwater, Okla.	0
86	Blackeye 7711, Stillwater, Okla.	10	19	Brabham, Tex., 31124, Beltsville, Md.	10
146	Blackeye (Wilt-resistant), Tyler, Texas	9+	68	Buff, Stillwater, Okla.	1
188	Blackeye (California No. 5), Chillicothe, Texas	10	5	Calva, Beltsville, Md.	10
164	Blackeye (California No. 5, SCP No. 21), Charleston, S. C.	10	4	Calva No. 6, Beltsville, Md.	10
28	Blackeye, California, Beltsville, Md.	10	27	Chinese Red, Beltsville, Md.	10
40	Blackeye, Early Ramshorn, Beltsville, Md.	10	147	Chinese Red (wilt-resistant), Tyler, Tex.	10
79	Blackeye, Early wilt-resistant Ramshorn, Stillwater, Okla.	10	24	Clay, Beltsville, Md.	10
48	Blackeye, Extra Early, Stillwater, Okla.	10	25	Clay Buff, Beltsville, Md.	10
36	Blackeye, Giant wilt-resistant Ramshorn, Beltsville, Md.	10	39	Columbia, Beltsville, Md.	9+
33	Blackeye, Large Virginia, Beltsville, Md.	10	12	Conch, Beltsville, Md.	3
67	Blackeye, Virginia, Stillwater, Okla.	10	173	Cream, SCP No. 13, Charleston, S. C.	9+
43	Black Cowpea, Beltsville, Md.	5	168	Cream, long pod, SCP No. 4, Charleston, S. C.	10
58	Blacks, Stillwater, Okla.	9+	77	Crowder, Blackeye White, Stillwater, Okla.	10
			63	Crowder, Brown, Stillwater, Okla.	3
			170	Crowder, Brown, Jackson 21, SCP No. 7, Charleston, S. C.	7
			162	Crowder, Calhoun L-35, Calhoun, Louisiana	10

Table 1. (Continued)

Beltsville no.	Variety or description and source	Disease rating[a]
29	Crowder, Cream, Beltsville, Md.	7
174	Crowder, Cream - Lady SCP No. 14, Charleston, S. C.	9+
89	Crowder, Cream, (selection from #29)	5
167	Crowder, Cream, (short pod) SCP No. 5, Charleston, S. C.	8
145	Crowder, Cream, (wilt-resistant) Tyler, Tex.	10
178	Crowder, Dixie Browneye, FC. 31711, Athens, Ga.	9
2	Crowder, Early Silver, Beltsville, Md.	10
158	Crowder L-Sp., Calhoun, La.	7
64	Crowder, Red Speckled, Stillwater, Okla.	6
80	Crowder, Speckled, Stillwater, Okla.	7
165	Crowder, Sugar or Brown Crowder, SCP No. 20, Charleston, S. C.	9
37	Crowder, White Brown-eyed Beltsville, Md.	9+
30	Dixie Queen, Beltsville, Md.	10
16	Early Buff, Beltsville, Md.	10
152	Early Dixie, Auburn, Ala.	10
15	Early Red, Beltsville, Md.	10
11	Groit, Beltsville, Md.	5
54	Holstein, Stillwater, Okla.	8
44	Holstein, (almost black), Beltsville, Md.	5
9	Honolulu, Beltsville, Md.	10
7	Iron, Beltsville, Md.	1
84	Iron, K329, Stillwater, Okla.	1
31	Lady or Rice, Beltsville, Md.	10
41	Lady Edible, Beltsville, Md.	10
103	Michigan Favorite, Barboursville, W. Va.	4
46	Nassau, Gainesville, Fla.	3
13	New Era, Beltsville, Md.	3
3	Potomac, Beltsville, Md.	10
14	Progressive White, Beltsville, Md.	10
172	Purple Hull, SCP No. 12, Charleston, S. C.	9+
171	Purple Hull, bunch, SCP No. 3 Charleston, S. C.	9+
34	Red Ripper, Beltsville, Md.	10
155	Simpson's Browneye, F.C. 31704, Calhoun, La.	10
166	Six weeks - Ala., SCP No. 9, Charleston, S. C.	1
76	Sumptuous, Stillwater, Okla.	10
47	Suwannee, Gainesville, Fla.	1
1	Taylor, Beltsville, Md.	8
6	Victor, Beltsville, Md.	1
85	Victor, K798, Stillwater, Okla.	2
17	Whippoorwill, Beltsville, Md.	10
32	Wood's Sumptuous, Beltsville, Md.	10
156	Jack. 21 - Ph-1, Calhoun, La.	9
157	41-1-53, Calhoun, La.	9
159	31 x Ph-171, Calhoun, La.	10
160	Ph x BSS - K-6, Calhoun, La.	9
161	L35 x Ph-7, Calhoun, La.	10
211	P.I. 91007, Vigna sinensis, China	10
212	P. I. 91069, Vigna sinensis, Manchuria	10
213	P.I. 91333, Vigna sinensis, China	10
130	P.I. 115,683, black cowpea, "Polon Leema"[b], Ceylon	10
129	P.I. 115,729, large red cowpea, "Don Arbain", Nigeria	10
126	P.I. 115,737, large red cowpea, No. 2, Nigeria	10
131	P.I. 115,739, large red cowpea, "Sokoto No. 2", Nigeria	10
133	P.I. 121,430, Poroto Todo elano, Paraguay	4
135	P.I. 121,433, Paraguay	4
124	P.I. 141,355, buff colored cowpea, Guatemala	10
125	P.I. 142,779, Mexico	10
45	P.I. 145,198, "Brabham", Australia	1
217	P.I. 145,199, Australia	10
218	P.I. 145,674, "Tucuman No. 22", Argentina	8
221	P.I. 145,731, Saudi Arabia	10
223	P.I. 146,113, Iran	10
112	P.I. 147,076, large red cowpea, Brazil	3
113	P.I. 147,077, browneye cowpea, Brazil	3
114	P.I. 147,078, large red cowpea, Brazil	4
224	P.I. 147,557, Colombia	9
115	P.I. 147,559, large red cowpea, Colombia	5
116	P.I. 147,561, large red cowpea, Colombia	4
117	P.I. 147,562, browneye cowpea, Colombia	5
118	P.I. 147,563, large browneye cowpea, Colombia	6
94	P.I. 148,671, Iran	10
95	P.I. 148,672, blackeye cowpea, Iran	10
226	P.I. 148,673, Iran	10

Table 1. (Continued

Beltsville no.	Variety or description and source	Disease rating[a]	Beltsville no.	Variety or description and source	Disease rating
119	P.I. 148,674, browneye cowpea, Iran	4	201	P.I. 163,143, blackeye cowpea, India	10
96	P.I. 148,675, blackeye cowpea, Iran	10	203	P.I. 163,320, India	10
97	P.I. 148,676, Holstein type, Iran	10	233	P.I. 164,298, India	10
120	P.I. 148,677, browneye cowpea, Iran	10	234	P.I. 164,308, India	10
98	P.I. 148,678, small red cowpea, Iran	10	235	P.I. 164,337, India	10
99	P.I. 148,679, small blackeye cowpea, Iran	10	240	P.I. 164,618, India	10
100	P.I. 148,680, small red cowpea, Iran	10	241	P.I. 164,619, India	8
101	P.I. 148,681, blackeye cowpea, Iran	10	242	P.I. 164,641, India	10
227	P.I. 148,682, Iran	10	243	P.I. 164,648, India	10
102	P.I. 148,683, large blackeye cowpea, Iran	10	244	P.I. 164,729, India	10
228	P.I. 151,104, "Frijol", Mono or Monkey Bean, El Salvador	10	245	P.I. 164,736, India	10
90	P.I. 151,555, small red cowpea, Dominican Republic	3	246	P.I. 164,764, India	10
143	P.I. 151,562, "Frijolitos (anconi) cabizeta blanca", Dominican Republic	10	247	P.I. 164,782, India	10
144	P.I. 151,563, "Frijolitos (anconi) cabizeta negra", Dominican Republic	9+	248	P.I. 164,785, India	10
138	P.I. 152,194, blackeye cowpea, Poroto "Tape," Paraguay	3	249	P.I. 164,979, Turkey	10
142	P.I. 152,195, Poroto "Ryta", Paraguay	3	250	P.I. 165,443, Mexico	7
136	P.I. 152,196, Poroto Sn Francisco, Paraguay	4	251	P.I. 165,454, Mexico	9
140	P.I. 152,197, Poroto Tupi Ryta, Paraguay	4	252	P.I. 165,467, Mexico	9
139	P.I. 152,198, Paraguay	3	253	P.I. 165,486, India	10
137	P.I. 152,199, Paraguay	2	254	P.I. 165,493, India	10
229	P.I. 154,133, large browneye cowpea, Peru	7	255	P.I. 165,923, India	10
230	P.I. 154,134, small blackeye cowpea, Peru	10	256	P.I. 165,941, India	10
179	P.I. 155,991, azuki bean, Eastern Carolines	9+	257	P.I. 166,146, India	9
184	P.I. 159,213, small red cowpea, South Africa	10	258	P.I. 166,369, India	10
185	P.I. 159,214, small red cowpea, South Africa	10	259	P.I. 167,024, Turkey	10
186	P.I. 159,869, Liberia	9	260	P.I. 167,029, Turkey	10
199	P.I. 162,699, Argentina	10	262	P.I. 167,229, Turkey	10
231	P.I. 162,924, Paraguay	7	263	P.I. 167,284, Turkey	2
232	P.I. 162,925, Paraguay	7	265	P.I. 170,843, Turkey	10
200	P.I. 163,142, mostly blackeye and small red cowpea, India	10	266	P.I. 170,844, Turkey	10
			267	P.I. 170,845, Turkey	10
			268	P.I. 170,846, Turkey	10
			269	P.I. 170,847, Turkey	10
			270	P.I. 170,848, Turkey	10
			271	P.I. 170,849, Turkey	10
			272	P.I. 170,850, Turkey	9
			273	P.I. 170,851, Turkey	10
			274	P.I. 170,852, Turkey	10
			275	P.I. 170,853, Turkey	10
			276	P.I. 170,854, Turkey	10
			278	P.I. 170,856, Turkey	10
			279	P.I. 170,857, Turkey	10
			280	P.I. 170,858, Turkey	10
			281	P.I. 170,859, Turkey	9
			282	P.I. 170,860, Turkey	10
			283	P.I. 170,861, Turkey	10
			284	P.I. 170,862, Turkey	10
			285	P.I. 170,863, Turkey	10
			286	P.I. 170,864, Turkey	10
			287	P.I. 170,865, Turkey	10
			289	P.I. 170,867, Turkey	9
			290	P.I. 170,868, Turkey	10
			291	P.I. 170,869, Turkey	10
			294	P.I. 170,872, Turkey	10
			295	P.I. 170,873, Turkey	10
			296	P.I. 170,874, Turkey	10

Table 1. (continued)

Beltsville no.	Variety or description and source	Disease rating	Beltsville no.	Variety or description and source	Disease rating
297	P.I. 171,066, Turkey	7	372	P.I. 181,833, India	10
307	P.I. 173,975, India	10	373	P.I. 181,902, India	10
308	P.I. 173,976, India	10	374	P.I. 181,926, India	10
310	P.I. 174,409, India	10	375	P.I. 181,927, India	10
311	P.I. 174,410, India	10	376	P.I. 182,316, India	10
312	P.I. 174,411, India	10	377	P.I. 182,317, India	10
313	P.I. 174,963, India	10	378	P.I. 182,318, India	10
314	P.I. 174,964, India	10	379	P.I. 183,003, India	8
315	P.I. 174,965, India	10	381	P.I. 183,089, India	7
316	P.I. 175,324, India	10	382	P.I. 183,090, India	10
318	P.I. 175,326, India	10	383	P.I. 183,091, India	10
319	P.I. 175,327, India	10	384	P.I. 183,360, India	10
320	P.I. 175,328, India	10	385	P.I. 183,361, India	10
321	P.I. 175,329, India	10	386	P.I. 183,362, India	10
322	P.I. 175,330, India	10	387	P.I. 183,363, India	10
323	P.I. 175,331, India	10	388	P.I. 183,364, India	10
324	P.I. 175,332, India	10	389	P.I. 183,365, India	10
326	P.I. 175,959, India	10	390	P.I. 183,366, India	10
327	P.I. 175,960, India	10	391	P.I. 183,426, India	10
328	P.I. 175,961, India	10	392	P.I. 183,427, India	10
329	P.I. 175,962, India	10	393	P.I. 183,480, India	10
330	P.I. 175,963, India	10	394	P.I. 183,481, India	10
331	P.I. 175,964, India	10	395	P.I. 183,482, India	10
332	P.I. 176,796, India	10	396	P.I. 183,250, blackeye cowpea, Egypt	10
333	P.I. 177,099, India	10			
334	P.I. 177,101, India	10	397	P.I. 183,251, blackeye cowpea, Egypt	10
335	P.I. 177,575, India	10			
336	P.I. 177,576, India	10	399	P.I. 184,673, Liberia	10
337	P.I. 177,577, India	10	401	P.I. 185,594, Union of South Africa	10
338	P.I. 177,578, India	10			
339	P.I. 177,579, India	10	400	P.I. 186,386, Uruguay	3
340	P.I. 177,580, India	10	403	P.I. 186,451, French Cameroons	10
341	P.I. 177,581, India	10	404	P.I. 186,452, French Cameroons	10
342	P.I. 179,124, India	10	405	P.I. 186,453, Nigeria	10
343	P.I. 179,125, India	10	406	P.I. 186,454, Nigeria	10
344	P.I. 179,126, India	10	407	P.I. 186,455, Nigeria	10
345	P.I. 179,553, India	10	408	P.I. 186,456, Nigeria	1
346	P.I. 179,554, India	10	409	P.I. 186,457, Nigeria	10
347	P.I. 179,555, India	10	411	P.I. 186,459, Nigeria	10
348	P.I. 179,556, India	10	412	P.I. 186,460, Nigeria	10
349	P.I. 179,557, India	10	413	P.I. 186,461, Nigeria	8
350	P.I. 179,558, India	10	414	P.I. 186,462, Nigeria	10
351	P. I 179,559, India	10	415	P.I. 186,463, Nigeria	9
353	P.I. 179,753, India	10	416	P.I. 186,464, Nigeria	10
354	P.I. 179,754, India	10	417	P.I. 186,465, Nigeria	10
356	P.I. 179,756, India	10	418	P.I. 186,466, Nigeria	10
358	P.I. 180,013, India	10	419	P.I. 186,467, Nigeria	10
359	P.I. 180,014, India	10	204	P.I. 163,321, Dolichos biflorus, India	3
360	P.I. 180,015, India	10			
361	P.I. 180,354, India	10	205	P.I. 163,105, Dolichos lablab, Delhi, India	2
363	P.I. 180,356, India	10			
364	P.I. 180,357, India	10	206	P.I. 163,106,Dolichos lablab, Delhi, India	0
365	P.I. 180,358, India	10			
366	P.I. 180,493, India	10	189	P.I. 156,057, Otoptera burchellii, Africa	0
369,	P.I. 180,496, India	10			
370	P.I. 180,497, India	10	303	Phaseolus sp. Formosa	1
371	P.I. 181,832, India	10			

Table 1. (Continued)

Beltsville no.	Variety or description and source	Disease rating
122	Phaseolus lunatus, Fordhook Lima - regular, Beltsville, Md.	1
123	Phaseolus lunatus, Henderson Bush Lima, Beltsville, Md.	1
18	Phaseolus vulgaris, Red Kidney Bean, Beltsville, Md.	6
121	Phaseolus vulgaris, Tennessee Green Pod, Beltsville, Md.	3
22	Vigna cylindrica, Catjang Brown, Beltsville, Md.	10
21	Vigna cylindrica, Catjang Buff, Beltsville, Md.	10
134	P.I. 124,606, Vigna cylindrica, Madras Presidency	2
219	P.I. 145,729, Vigna cylindrica, Saudi Arabia	10
220	P.I. 145,730, Vigna cylindrica, Saudi Arabia	10
236	P.I. 164,428, Vigna cylindrica, India	10
238	P.I. 164,519, Vigna cylindrica, India	10
239	P.I. 164,532, Vigna cylindrica, India	10
317	P.I. 175,325, Vigna cylindrica, India	10
325	P.I. 175,333, Vigna cylindrica, India	10
352	P.I. 175,752, Vigna cylindrica, India	10
355	P.I. 179,755, Vigna cylindrica, India	10
357	P.I. 179,757, Vigna cylindrica, India	10
362	P.I. 180,355, Vigna cylindrica, India	10
367	P.I. 180,494, Vigna cylindrica, India	10
368	P.I. 180,495, Vigna cylindrica, India	10
380	P.I. 183,088, Vigna cylindrica, India	10
402	P.I. 186,450, Vigna cylindrica, British Cameroons	10
187	Vigna repens, Ocean Springs, Miss.	1
163	P.I. 115,038, Vigna sesquipedalis, Ceylon	9
127	P.I. 115,679, Vigna sesquipedalis, "Hodi", Ceylon	1
128	Vigna sesquipedalis, "Polon", Ceylon	2
301	Vigna sinensis, South China or Formosa	1
88	Vigna sinensis, (New Era Markings on red background), Gainesville, Fla.	4
177	P.I. 106,460, Vigna sp., Urundi District, Africa	8
180	P.I. 158,831, Vigna sp., Paraguay	0
210	P.I. 171,985, Vigna sp., Dominican Republic	0
306	P.I. 182,025, Vigna sp., Liberia	0
398	P.I. 183,267, Vigna sp., Arabia	10
420	P.I. 186,471, Vigna spp., French Cameroons	10
300	Vigna sp., South China or Formosa	1
302	Vigna sp., South China or Formosa	0
304	Vigna sp., South China or Formosa	1
305	Vigna sp., South China or Formosa	0
298	P.I. 181,584, Vigna triloba, Union of South Africa	0
181	P.I. 159,210, Vigna vexillata, South Africa	0
197	P.I. 159,212, Vigna vexillata, South Africa	4
299	P.I. 181,585, Vigna wilmsii, Union of South Africa	5
194	P.I. 163,446, "Azul Grande" (No. 0150), selection from New Era x Sugar Crowder cross, Turrialba, Costa Rica	2
193	P.I. 163,447, "Canelo" (No. 0128), selection from Conch x Potomac cross, Turrialba, Costa Rica	8
191	P.I. 163,448, "Chinegro" (No. 0189), selection from Yardlong x Cowpea cross, Turrialba, Costa Rica	5
192	P.I. 163,449, "Chinito" (No. 0190), selection from (Yard-long x Cowpea) x "Azul Grande", Turrialba, Costa Rica	3
190	"Garbancito" (No. 0151), selection from New Era x Sugar Crowder cross, Turrialba, Costa Rica	7

[a] 0=immune; 1-2= highly resistant; 3-4 = moderately resistant; 5-7 = moderately susceptible; and 8-10 = susceptible.

[b] Words in quotations are native names.

STRAINS OF X. VIGNICOLA

In the course of these investigations, additional isolations of the bacterial canker organism were made from different varieties collected at several locations. Following is a list of the culture numbers, hosts, locations, and dates the isolations were made.

Culture no.	Source	Date isolated
1	Re-isolate from Catjang Buff variety inoculated with XV18 sent by Dr. Burkholder	Jan. 1946
2	Re-isolate from Blackeye variety inoculated with an isolate from Blackeye Cowpea, Cherokee County, Texas	Jan. 1946
3	Chinese Red Cowpea.	Aug. 1946
4	Whippoorwill Cowpea, Raleigh, North Carolina	Aug. 1946
5	Whippoorwill Cowpea, Raleigh, North Carolina	Aug. 1946
6	Cowpea, Experiment, Georgia	Nov. 1946
7	Groit Cowpea, Stillwater, Oklahoma	Sept. 1946
8	Cowpea, Chillicothe, Texas	Feb. 1947
9	Clay Cowpea, Stillwater, Oklahoma	Feb. 1947

In order to test the pathogenicity of these isolates and to determine whether there were different strains of the organism, plants of nine cowpea collections were inoculated in the greenhouse with the above nine cultures by the stem-puncturing method. Following inoculation, half of the plants were incubated in a greenhouse held at 27° C., and the other half at about 35-45° C. Reactions of the nine cowpea collections to the nine bacterial cultures at the two temperatures are shown in Table 2.

Table 2. Disease ratings of nine cowpea collections inoculated with nine isolates of Xanthomonas vignicola at two temperatures.

	Isolates																	
Variety	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
	27° C.									35-45° C.								
Blackeye	7	10	9	10	10	10	10	19	10	9	10	10	10	10	10	10	10	10
Chinese Red	7	10	10	10	10	9	10	10	10	9	9	10	9	10	10	10	10	10
Groit (Beltsville No. 11)	1	4	3	3	2	3	10	4	3	4	7	7	7	7	8	9	7	7
Groit (Beltsville No. 55)	2	4	2	3	2	1	10	3	4	1	5	5	5	4	7	10	6	5
Groit (Beltsville No. 93)	2	4	2	4	2	4	10	4	4	1	7	5	7	7	7	9	5	7
Iron K329	1	1	1	1	2	1	1	1	1	2	3	1	4	4	3	3	1	2
New Era (Beltsville No. 53)	1	3	2	4	1	2	9	5	4	1	5	3	4	5	7	9	5	7
Victor	1	1	1	3	2	3	1	1	2	1	1	1	3	3	1	1	1	2
Whippoorwill	7	10	10	10	10	10	10	9	9	8	9	9	9	9	9	9	10	10

From these data it seems there are two distinct strains of Xanthomonas vignicola that attack cowpeas. Strain 1 includes all the cultures tested except No. 7, which constitutes Strain 2. The varieties Groit and New Era were highly resistant to moderately susceptible to Strain 1 except at higher temperatures; but they were susceptible to Strain 2 even at lower temperatures. Two sets of plants of the variety Groit inoculated separately with the two strains of X. vignicola are shown in Figure 4. It is interesting to note that Groit, which is a selection from New Era x Whippoorwill, apparently carries the same genes for resistance to Strain 1 as does its New Era parent.

EFFECT OF TEMPERATURE ON DISEASE DEVELOPMENT

To determine the effect of temperature on disease development, three sets of plants, including four varieties of cowpeas, were inoculated by the stem-puncturing method and one set was placed in each of three constant temperature rooms at 20° C., 25° C., and 30° C., respectively.

FIGURE 4. Groit cowpeas inoculated with two strains of Xanthomonas vignicola. Plants in pot at left were inoculated with Strain 2 isolated from Groit cowpea, Stillwater, Oklahoma; those at right with Strain 1 isolated from Whippoorwill cowpea, Raleigh, North Carolina.

Three susceptible varieties, Chinese Red, Catjang Buff, and Blackeye, and one resistant variety, Victor, were used. As shown in Table 3, the highest percentage of plants with cankers, one week after inoculation, was at 30° C., the next highest at 25° C., and the lowest at 20° C. Of the susceptible plants inoculated, 100 percent were dead after two weeks at 30° C., 44.8 percent at 25° C., and 17.2 percent at 20° C. These data suggest the disease develops more rapidly at the higher temperatures.

Table 3. Effect of temperature on the development of bacterial canker in four varieties of cowpeas.

Temperature	Variety	Number of plants inoculated	1 week after inoculation: Percent with cankers	1 week after inoculation: Percent dead	2 weeks after inoculation: Percent with cankers	2 weeks after inoculation: Percent dead	Total percent of susceptible plants dead
20° C.	Chinese Red	10	0	0	100	10.0	
	Catjang Buff	9	33.3	0	100	44.4	
	Blackeye	10	20.0	0	100	0	
	Victor	10	0	0	0	0	
							17.2
25° C.	Chinese Red	10	50	0	100	50.0	
	Catjang Buff	9	88.9	0	100	44.4	
	Blackeye	10	80.0	0	100	40.0	
	Victor	10	0	0	0	0	
							44.8
30° C.	Chinese Red	10	100	0	100	100	
	Catjang Buff	10	100	0	100	100	
	Blackeye	10	100	0	100	100	
	Victor	10	0	0	0	0	
							100

Duplicate sets of plants were placed in greenhouses at 27° C. and 34-45° respectively, to determine whether the reaction of some varieties to different cultures could be changed. In some cases, susceptibility was increased at the higher temperature (Table 2). The Groit numbers and New Era, which had comparatively low readings to all cultures except 7 at 27° C., had high readings at 35-45° C., with most of the cultures. Culture 1 appeared to be the least pathogenic throughout the inoculations, possibly because pathogenicity of this culture was reduced by aging.

Table 4. Pathogenicity of Xanthomonas vignicola cultures repeatedly passed through the host plants inoculated[a].

Culture number	Source	Date of isolation[b]	WHIPPOORWILL Number of plants inoculated	WHIPPOORWILL Percent With heavy cankers	WHIPPOORWILL Percent With light cankers	WHIPPOORWILL Percent With heavy streaks	WHIPPOORWILL Percent Dead	CHINESE RED Number of plants inoculated	CHINESE RED Percent With heavy cankers	CHINESE RED Percent With light cankers	CHINESE RED Percent With heavy streaks	CHINESE RED Percent Dead
4	Whippoorwill Cowpea Raleigh, N. C.	8/19/46	9	55.6	33.3	0	11.1	9	66.6	0	0	33.3
17	Whippoorwill Cowpea inoculated with 4	9/30/47	10	70.0	20.0	0	10.0	10	40.0	0	0	60.0
13	Whippoorwill Cowpea inoculated with 12[c]	2/18/48	9	55.6	0	0	44.4	10	30.0	0	0	70.0
14	Whippoorwill Cowpea inoculated with 13	10/ 1/48	10	80.0	0	0	20.0	10	50.0	10.0	0	40.0
18	Whippoorwill Cowpea inoculated with 14	1/31/49	10	50.0	0	0	50.0	9	33.3	0	0	66.6
10	Chinese Red Cowpea	2/ 5/45	9	33.3	0	0	66.6	9	0	0	0	100
15	Chinese Red Cowpea inoculated with 10	1/20/46	8	50.0	0	0	50.0	10	40.0	10.0	0	50.0
16	Chinese Red Cowpea inoculated with 15	9/30/47	10	40.0	10.0	0	50.0	10	20.0	0	0	80.0
19	Chinese Red Cowpea inoculated with 16	2/18/48	9	44.4	11.1	22.2	22.2	10	60.0	10.0	0	30.0
11	Chinese Red Cowpea inoculated with 19	10/ 1/48	10	30.0	60.0	10.0	0	10	20.0	50.0	30.0	0
20	Chinese Red Cowpea inoculated with 11	1/31/49	10	80.0	0	0	20.0	10	60.0	0	0	40.0

[a]Notes were taken four weeks after inoculation.
[b]Cultures have been transferred since they were originally isolated.
[c]Same source as 17.

Table 5. Pathogenicity of Xanth...

Table 5. Pathogenicity of Xanthomonas vignicola grown on potato-dextrose agar and repeatedly transferred; plants inoculated 3-3-49.

Culture number	Source	Date of transfer[a]	WHIPPOORWILL					CHINESE RED				
			Number of plants inoculated	Percent				Number of plants inoculated	Percent			
				With heavy cankers	With light cankers	With heavy streaks	Dead		With heavy cankers	With light cankers	With heavy streaks	Dead
21	Chinese Red Cowpea	8/8/47	15	60.0	0	6.7	33.3	10	50.0	10.0	10.0	30.0
	" " "	2/9/48	9	66.7	0	0	33.3	10	60.0	0	0	40.0
	" " "	2/3/49	9	33.3	0	0	66.6	9	33.3	0	0	66.7
4	Whippoorwill Cowpea	8/8/47	9	55.6	22.2	0	22.2	8	75.0	0	0	25.0
	" "	2/5/48	9	22.2	0	0	77.7	9	22.2	0	0	77.8
	" "	2/2/49	10	80.0	0	0	20.0	9	88.9	0	0	11.1
22	Whippoorwill Cowpea	8/8/47	9	33.3	0	0	66.7	10	20.0	0	0	80.0
	" "	2/5/48	10	90.0	0	0	10.0	10	50.0	10.0	0	40.0
	" "	2/4/49	10	30.0	0	0	70.0	10	40.0	0	0	60.0

[a]Dates of original isolations were: 21 - 1/20/46; 4- 8/19/46; and 22 - 8/19/46.

VIABILITY AND PATHOGENICITY OF CULTURES

In order to check the viability and pathogenicity of certain Xanthomonas vignicola isolates, they were inoculated into their original hosts at about 3- to 6-month intervals and then re-isolated and used in subsequent inoculations. One culture from the variety Chinese Red was passed through that host five times, and an isolate from the variety Whippoorwill was passed through its host five times. These re-isolations were made over a period of approximately three to four years. At the end of this time, the varieties Whippoorwill and Chinese Red were inoculated with all of the isolates and re-isolates from both cultures. In Table 4 are shown the culture numbers, their sources and dates of isolation, and the results of the inoculations. Disease readings were made four weeks after inoculation.

It appears there is no definite correlation between age of culture and pathogenicity. In one case (isolate 4), the oldest culture of the series was the least pathogenic; in another case (isolate 10), the oldest culture of the series was the most pathogenic. It was observed that repeated passage of the organism through the host did not increase its virulence. However, there was variation in the pathogenicity of the isolates, as can be observed in Table 4. Culture 11 was the least pathogenic isolate on both hosts.

Another group of cultures that had been transferred at intervals without host passage was tested to determine whether age and repeated transfer had affected pathogenicity. All cultures in this group had been covered with mineral oil since they were transferred. In Table 5 are shown the culture numbers, sources, dates of transfer, and disease readings. All cultures had been originally isolated about one year earlier than the first transfer dates recorded, but the original isolates were discarded when the transfer was made. From the disease ratings in Table 5, it appears there was no correlation between age of culture and pathogenicity.

SUMMARY

In inoculation tests to determine the pathogenicity of Xanthomonas vignicola and Xanthomonas phaseoli on various hosts, it was found that X. vignicola was pathogenic on most varieties of Vigna sinensis but not on any varieties of Phaseolus vulgaris tested, except Red Kidney. X. phaseoli was pathogenic on all bean varieties tested but did not form typical blight symptoms on any cowpea varieties. On Groit and New Era varieties of cowpea X. phaseoli produced dark, narrow streaks one to three inches long above and below the point of inoculation.

The best method for inoculating cowpeas with X. vignicola was to puncture the stem twice with an arrow-point needle through a bacterial smear just below the primary leaves when the first trifoliolate leaves were starting to unfold. The earliest symptom produced by this method was a chlorotic, swollen, blistered area around the punctures several days after inoculation, which later spread in a streak up and down the stem. This was followed by discoloration and cracking of the tissue to form a canker. The primary leaves often wilted without development of distinct lesions, and the trifoliolate leaves frequently were stunted and wilted. Spherical water-soaked lesions a few millimeters to one centimeter in diameter with necrotic centers, or irregular, yellowish, water-soaked areas a few millimeters to several centimeters in diameter sometimes appeared on the leaves. Severe cankers and leaf symptoms were present on susceptible plants two weeks after inoculation.

Of the named varieties of V. sinensis tested for their reaction to X. vignicola those that were considered immune or highly resistant were Brabham, Buff, Iron, Six-weeks-Ala. (SCP No. 9), Suwannee and Victor; those moderately resistant were Brown Crowder, Conch, Michigan Favorite, Nassau, and New Era; and those rated as moderately susceptible were Alabunch, Black, Blue Goose, Brown Crowder (Jackson 21, SCP No. 7), Cream Crowder and a Cream Crowder selection, Crowder (L-sp.), Red Speckled Crowder, Speckled Crowder, Groit, and Holstein (almost black). A number of introductions and selections of V. sinensis and some other species and genera tested, also were placed in one of the above categories.

Two strains of X. vignicola were found. The varieties Groit and New Era were resistant or moderately susceptible to Strain 1 when a greenhouse temperature of 27° C. was maintained. Strain 2, which included only one culture (No. 7), isolated from Groit Cowpea collected at Stillwater, Oklahoma, produced typical, severe bacterial canker symptoms on Groit and New Era at 27° C.

Comparatively high temperatures favored the growth of the organism and disease development. No definite correlation between the age of a culture and its pathogenicity was found. The pathogenicity of X. vignicola was not increased by repeatedly passing the organism through its host.

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DIVISION OF FORAGE CROPS AND DISEASES, BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING

WATER FLOW THROUGH SOYBEAN STEMS INFECTED WITH BROWN STEM ROT[1]

Dean F. McAlister and Donald W. Chamberlain[2]

The brown stem rot disease (Cephalosporium gregatum) of soybeans in some seasons produces a sudden withering and browning of the leaves as the plants are approaching maturity. Observations over a five-year period showed that the leaf symptoms have been abundant only in seasons when a warm, dry period late in August or early September followed a period of relatively cool weather. Since the fungus is known to be largely a vascular parasite, it appeared possible that the presence of the fungus in the vessels of the stem might be interfering with the movement of water through the stems to the point of producing a damaging drought in the leaves. Other evidence suggesting that leaf symptoms of brown stem rot could be the result of a water deficit was the similar reaction of leaves of healthy soybean plants, when exposed to soil and air drought under either field or controlled conditions in the greenhouse.

To obtain information relative to this theory, an experiment was designed to measure the effect of brown stem rot on water flow through soybean stems. Diseased and healthy plants of the Lincoln variety were collected on three different dates and brought into the greenhouse. Two sections, one below and one above the branch-bearing nodes, were cut from each stem. The lower section was 7 cm. long, including the second and third nodes; the upper section, 13 cm. long, including the eighth and ninth nodes. The sections from diseased stems were classified as heavily, moderately, or lightly browned on the basis of the degree of browning evident in cross section at the basal end. Those showing no browning were termed healthy. All sections were kept in water until tested.

The following apparatus was constructed for the water flow measurements presented. The male half of a 3/8-inch pipe union was enlarged and tapered to receive a No. 3 rubber stopper. This fitting was soldered to one end of a 10-inch length of a 1 1/2-inch copper tubing and a 1/4-inch pipe union soldered to the other end to serve as an air inlet and as an opening for adding water. A hole was bored in each of several No. 3 soft rubber stoppers to accommodate the varying sizes of stems likely to be encountered. A stem section was inserted into a stopper and the stopper placed in the tapered hole in the pipe union. Pressure was applied to the stopper by placing a metal washer in the union nut and turning the latter onto the threads of the union. Hand pressure on the nut was sufficient to insure a snug fit of the rubber stopper onto the surface of the stem without damaging the latter. Distilled water was poured into the reservoir formed by the copper tubing, and air pressure of approximately one atmosphere (15 pounds/square inch) applied. A 30-second period was allowed in each instance for any air present in the vascular elements to be expelled before water flow measurements began. Comparisons of stem sections were based on the amount of water forced through in four minutes. The diameter of each stem section was measured at the basal end and the end-area computed.

A summary of the results is presented in Table 1. The data show that the mean rate of water flow was less than half as great in stem tissue invaded by the brown stem rot fungus as in healthy tissue for comparable stem sizes. Water flow in the upper stem segments was much less from both types of tissue than from the lower part of the stem, but the relative flow from infected versus healthy remained about the same. The lower rates of flow in the upper stem samples was a reflection of decreased amounts of vascular elements present and the longer sections of stems through which the water traveled.

The data also indicate that there was an inverse relationship between the degree of browning in the vascular system and the rate of water flow. In the lower stem, the quotient of volume (cc.) of water expelled in four minutes divided by the cross sectional area (cm^2) of the stem was 37.5, 64.8, 82.1, and 128.6 for the samples classified as heavy, moderate, light, and no browning, respectively. A comparison in the same sequence for the upper stem samples gave quotients of 12.5, 48.6, 51.3, and 55.0. While these results were based on visual estimation of the amount of browning in the stems, previous histological observations indicated that the degree of browning in the vascular tissue was directly related to the extent of invasion by Cephalosporium gregatum.

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Table 1. Rate* of water flow through sections of diseased and healthy soybean stems.

Date of Measurements	Degree of vascular browning: Heavy Stem size cm^2	Heavy Flow cc.	Moderate Stem size cm^2	Moderate Flow cc.	Light Stem size cm^2	Light Flow cc.	None Stem size cm^2	None Flow cc.
Lower stem sections (7cm)								
9/22/50	.61	27	.50	42	.55	57	.57	113
No. Samples	1		3		2		4	
9/27/50	.46	17	.59	27			.43	51
No. Samples	3		1				4	
10/3/50	.78	28	.59	21	.58	25	.66	57
No. Samples	4		1		1		5	
Means	.64	24	.54	35	.56	46	.56	72
Means for all infected stems (7 cm)			.59	32				
Upper stem sections (13cm)								
9/22/50	.41	12	.35	17	.39	20	.38	24
No. Samples	1		1		4		4	
9/27/50	.33	5					.34	15
No. Samples	4						4	
10/3/50	.45	5					.47	25
No. Samples	6						5	
Means	.40	5	.35	17	.39	20	.40	22
Means for all infected stems (13 cm)			.40	10				

*Volume of water exuded under a positive pressure of 15 lbs./sq. inch during a four-minute period.

Although the results presented are subject to the criticism of in vitro measurements, they do suggest that the presence of the fungus in the vessels of the stem may seriously interfere with water transport in the plant. If the supply of water to the leaves were restricted to one-third or one-fourth of normal, as indicated from these data for heavily infected stems, it is likely that during periods of intense transpiration the portions of the leaves most distant from the large veins would be desiccated to the point of death. Such a situation may explain the characteristic leaf symptoms caused by the brown stem rot fungus during weather conditions favorable to their development.

U. S. REGIONAL SOYBEAN LABORATORY, URBANA, ILLINOIS

SOYBEAN DISEASES IN IOWA IN 1950[1]

J. M. Crall

Diseases of major importance on soybean in Iowa in 1950 were: stem canker (Diaporthe phaseolorum var. batatatis), brown stem rot (Cephalosporium gregatum), and root and stem rot (Rhizoctonia solani). Diseases of lesser importance included: bud blight (virus), mosaic (virus), yellow mosaic (virus), bacterial blight (Pseudomonas glycinea), bacterial pustule (Xanthomonas phaseoli var. sojense), wildfire (Pseudomonas tabaci), brown spot (Septoria glycines), downy mildew (Peronospora manshurica), anthracnose (Colletotrichum truncatum), charcoal rot (Macrophomina phaseoli), pod and stem blight (Diaporthe phaseolorum var. sojae), seedling blight (Rhizoctonia solani), and purple stain (Cercosporina kikuchii). Potash deficiency spots were found in a moderate number of fields, especially in northcentral Iowa. Some slight injury was caused by early frosts in the northern half of the State.

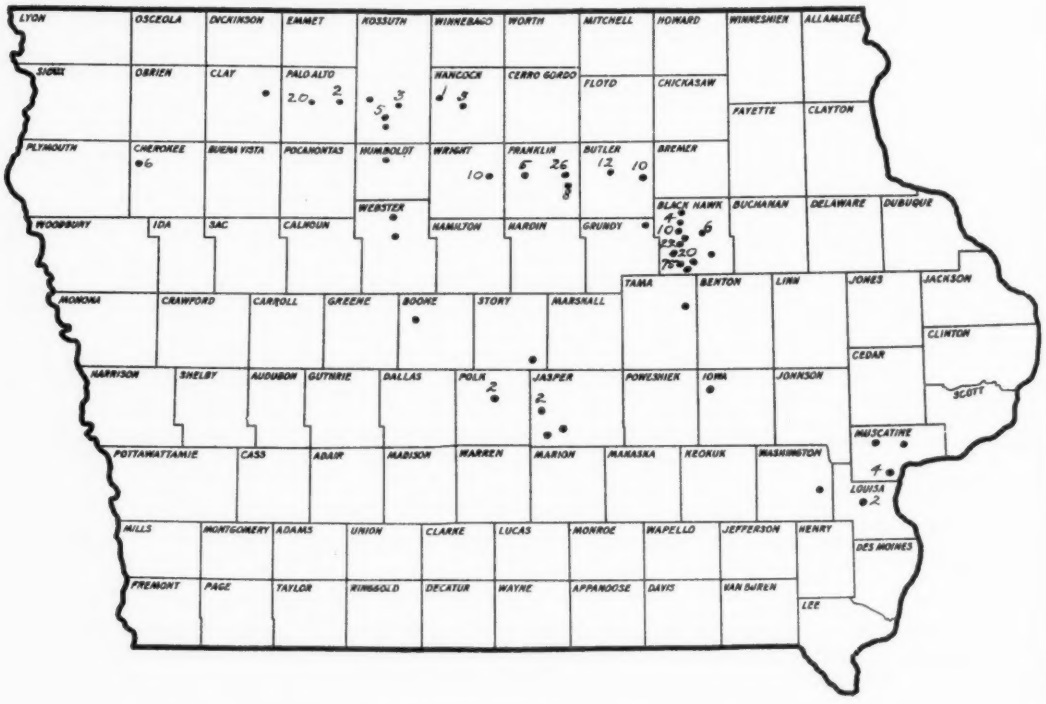

FIGURE 1. Occurrence of Diaporthe stem canker on soybean in Iowa in 1950. Each dot represents a field in which a trace or more of infection was found. Figures represent percentage of plants infected where infection was more than a trace.

Stem canker occurred in practically every soybean field in Iowa in 1950. Although the intensity of this disease, in general, was slightly less than in 1949, its widespread occurrence made it the most important disease during the past season. Stem canker was found first on August 22 at various locations in northern Iowa, although it probably was present as early as August 15. It was noted first at Ames on August 31, two weeks later than in 1949. The accompanying map (Fig. 1) shows the 1950 distribution of the disease. Widespread occurrence of the disease in northwest Iowa, contrasted with its complete absence there in 1949, is noteworthy. Most severe infection was 75 percent, in a field in which severe infection occurred in 1949 also.

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[1]Journal Paper No. J-1952 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project No. 1179.

Brown stem rot was found as early as August 23. This disease was found in widely scattered fields in central and eastern Iowa, distribution of the occurrences approximating that in 1949[2]. It was found for the first time in the Agronomy Farm plots at Ames.

Rhizoctonia root and stem rot caused slight damage in numerous fields and moderate to severe damage in a few fields, especially in northeastern Iowa. The greatest amount of infection in any field was 50 percent. It was most common from mid-July to mid-August. Damage appeared to be aggravated in some cases by local droughty conditions.

Bacterial blight, the most common bacterial leaf spot in 1950, was prevalent in most fields. Bacterial pustule, though prevalent in most fields in 1949, was very limited in occurrence in 1950. Wildfire was found in only a few fields in southeast Iowa.

DIVISION OF FORAGE CROPS AND DISEASES, BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING, AND IOWA AGRICULTURAL EXPERIMENT STATION, AMES, IOWA

[2]Crall, J. M. Soybean diseases in Iowa in 1949. Plant Dis. Reptr. 34: 96-97. 1950.

DISEASES ON RED CLOVER AND ALFALFA IN IOWA IN 1950[1]

J. M. Crall

RED CLOVER

The most important diseases on red clover in Iowa in 1950 were: summer black stem and leaf spot (Cercospora zebrina), rust (Uromyces trifolii), powdery mildew (Erysiphe polygoni), and Stemphylium leaf spot (S. sarcinaeforme). Diseases of lesser importance included: wilt (believed to be caused by Fusarium oxysporum), spring black stem (Phoma trifolii), leaf spot (Stemphylium botryosum), leaf spot (Pseudoplea trifolii), northern anthracnose (Kabatiella caulivora), and virus ringspot[2].

The angular leaf spot and stem blackening caused by Cercospora zebrina occurred commonly on both first and second year plants. It was found in July and early August in slight to moderate amounts and intensities and after mid-August in moderate to abundant amounts and moderate to severe intensities.

Rust was more prevalent than usual, especially on second-year plants, being found after mid-August in slight to moderate amounts and moderate to severe intensities. Stemphylium leaf spot and powdery mildew occurred in July and early August in slight to moderate amounts and generally slight intensities and in late August and September in slightly increased amounts and intensities.

Fifteen to 100 percent of the taproots of second year plants were markedly discolored in early May. Cause of the discoloration was not determined. Wilting, associated with taproot discoloration, of first year plants was found in July and early August, but only in trace amounts in a few fields. No wilting and only slight amounts of taproot discoloration were found after mid-August. Weather conditions were believed unfavorable for the development of wilt in 1950.

ALFALFA

The most important diseases on alfalfa in Iowa in 1950 were: summer black stem and leaf spot (Cercospora zebrina), common leaf spot (Pseudopeziza medicaginis), and downy mildew (Peronospora trifoliorum). Diseases of lesser importance included: Rhizoctonia root rots (R. solani and R. crocorum), Pseudoplea leaf spot (P. trifolii), spring black stem (Ascochyta imperfecta), yellow leaf blotch (Pseudopeziza jonesii), rust (Uromyces striatus medicaginis), and bacterial wilt (Corynebacterium insidiosum).

The leaf spot and stem blackening caused by Cercospora zebrina occurred in July and early August in slight to moderate amounts and intensities and in late August and September in abundant amounts and moderate to severe intensities. Common leaf spot was found in July and early August in slight to moderate amounts and intensities and in late August and September in moderate to abundant amounts and slight to moderate intensities. Downy mildew was present throughout the season in slight to moderate amounts and intensities. Other diseases were relatively unimportant, although Pseudoplea leaf spot was found more commonly than usual.

DIVISION OF FORAGE CROPS AND DISEASES, BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING, AND IOWA AGRICULTURAL EXPERIMENT STATION, AMES, IOWA

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[1]Journal Paper No. J-1953 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project No. 1048.

[2]Johnson, E. M. A ringspot-like virus disease of red clover. Phytopath. 23: 746-747. 1933.

ROOT-KNOT NEMATODES ON PEAS AND VETCH IN LOUISIANA

J. G. Atkins, Jr.

In Louisiana vetch and field or winter peas, such as the Austrian Winter pea, have not been considered as being subject to severe attack by the root-knot nematode, Heterodera marioni (Meloidogyne spp.). The general consensus has been that various nematode-susceptible crops, among them peas, escape infection owing to the inactivity of the nematodes during the cool months of the year. Austrian Winter peas, Pisum arvense, were found on January 23, 1951, to be heavily infected with root knot on a farm in Tangipahoa Parish near Hammond, Louisiana. About five acres of peas had been planted in early November following a fall cucumber crop which had also shown rather severe root-knot nematode injury. Light root-knot nematode infection was also found on Austrian Winter peas on November 15, 1950, near Cheneyville, Louisiana. Approximately 160 acres had been planted on one plantation in October following cotton. Some test plots at Baton Rouge planted November 9, 1950, were examined in late January for root-knot galls. Infection was severe on hairy vetch (Vicia villosa), heavy on Austrian Winter peas and light on common vetch (V. sativa). Figure 1 shows typical root knot on Austrian Winter peas collected January 23, 1951, at Baton Rouge, Louisiana, from test plots planted in November.

According to weather records for November 1950, the average monthly temperature was lower than normal. In general, November and December 1950 and January 1951 were colder than normal. However, in spite of the lower winter temperatures this year, observations indicate that root-knot nematodes are capable of causing rather severe galls on the roots of peas and vetch.

FIGURE 1. Root knot on Austrian Winter peas.

This note has been prepared to point out that root-knot infection has been found to be much more severe on peas and vetch than expected, and that the planting of these winter legumes may tend to increase the root-knot nematode population in the soil. Although severely infected pea and vetch plants have been collected from two small plantings, the extent and importance of this disease on these legumes has not been determined. Even though we may classify root knot as a minor disease on peas and vetch when used as winter legumes, which appears probable, the effect of plowing under infected plants on the following nematode-susceptible, warm-weather crops, such as cucumbers or cotton, may be important. The use of non-susceptible crops during the warm months in a rotation program has been recommended in Louisiana, as in other States, as a partial control measure in fields where root knot has become severe on susceptible crops. Recent observations indicate that the relative susceptibility of the winter legume should probably be considered in areas where soils are known to be heavily infested. Mature females were observed within infected roots in March, which indicates that the nematodes are capable of completing their cycle.

DEPARTMENT OF PLANT PATHOLOGY, LOUISIANA AGRICULTURAL EXPERIMENT STATION, BATON ROUGE, LOUISIANA

METHOD FOR USE OF SOIL FUMIGANTS TO CONTROL ROOT ROT AND SEED DECAY IN PEAS AND BEANS[1]

R. D. Watson

Soil fumigant fungicides have been used very little in controlling soil-borne plant diseases in Idaho. The chief reasons are the extremely high per-acre cost which has restricted their use, and the lack of complete eradictaion of the organism. Many of our most serious diseases are caused by soil-borne fungi, and usually our only practical control has been to rotate the crops. The increased acreage given to cash crops has intensified the problem. This has been true of the so-called "root rot" on peas and beans caused by several fungi, Fusarium species being the chief offender. The "root rot" is a stem and primary root decay that often girdles the plant near the seed attachment region early in the season. This girdling leaves only the secondary roots to support the plant to maturity.

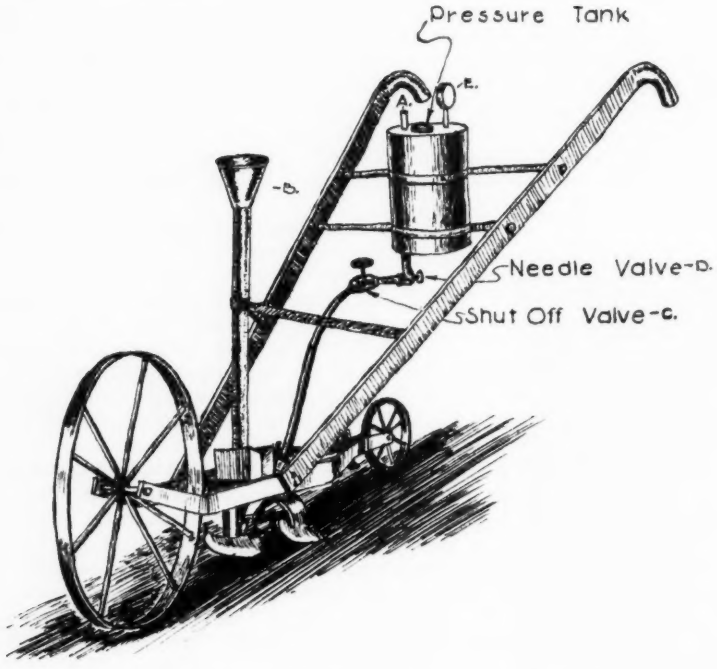


FIGURE 1. Experimental planter showing soil fungicide applicator.
A. Pressure attachment is an auto tire valve. The pressure can be developed by a tire pump or other means.
B. Quantities of counted seed can be applied through the funnel and tube attachment.
C. Shut-off valve is used for end of row.
D. The needle valve for adjustment of the rate of flow.
E. Pressure gauge.

These diseases are widespread and present a major problem. Soil sterilization with soil fumigants is not practical on these crops with present methods.

Seed treatment work would indicate that some control could be achieved by heavy dosages of fungicide at the seed level, since much of the "root rot" develops at or near the seed piece attachment. Seed treatment did not offer a solution, so a new method of application of soil fumigants was tried as the next phase of the research. A fungicide which could be applied with

[1] Published with the approval of the Director of the Idaho Agricultural Experiment Station as Research Paper No. 336.

the seed in such a manner that it would sterilize a local area and be dissipated before causing injury to the seed was sought. A drip process based on the onion smut control method was used. It offers a fresh approach for the wider use of the newer soil fumigants in plant disease control.

A simple attachment has been adapted to the planter to apply the fungicide with the seed (Fig. 1). Using methods already developed for use on nematode control these fumigants can be placed below the seed level should that be necessary for the control of certain diseases. It would appear that this method of applying fungicidal fumigants for disease control could have a wide application with little change in our present practices.

In the preliminary greenhouse and field tests of 1950 two products were used, formaldehyde and Shell product O.S.840. In 1951 the name O.S.840 was changed to CBP-55. This material is "technical chlorobromopropene". From these first tests there appears to be a wide range of practical concentrations between the toxic level of the seed and the lower limits of control of the diseases.

Formaldehyde in field tests caused injury at 4.7 gallons per acre on peas, beans, and lima beans. It gave increased yields at 3 gallons per acre, and best results of stand, yield and control of root rot at 1.5 gallons per acre. This would indicate that under our conditions formaldehyde at about 1.5 to 2 gallons would be the most valuable concentration for further testing.

The Shell product CBP-55 was effective over a wide range of concentrations. Control was noticeable at as low as 0.2 gallons per acre, and tests up to 2 gallons per acre gave increasing control and did not cause injury under field conditions. Applications in "gallons per acre" were calculated on a two-foot row spacing.

IDAHO AGRICULTURAL EXPERIMENT STATION, MOSCOW

THE POTATO WART ERADICATION PROGRAM IN PENNSYLVANIA

Russell Hyre

Last fall, on October 16-20, 1950, the writer studied the eradication program for potato wart (Synchytrium endobioticum) in Pennsylvania. The processes of total destruction of gardens and berms, and preparation of gardens for standard eradication, were observed. [1]

During May this year, through the courtesy of Dr. R. E. Hartman of the Pennsylvania State Department of Agriculture, this study was continued. One and one-half days, May 22-23, 1951, were spent with Dr. Hartman or the eradication crew in the field at the time of planting potatoes. The same meticulous care was maintained in sterilizing equipment and footwear with formaldehyde when moving from one garden to the next that was observed last fall.

The photographs (Figure 1, A to H) show the sterilization of equipment, the preparation and planting of gardens, and the lack of plant growth on areas on which vegetation had been totally destroyed with copper sulfate about four years before.

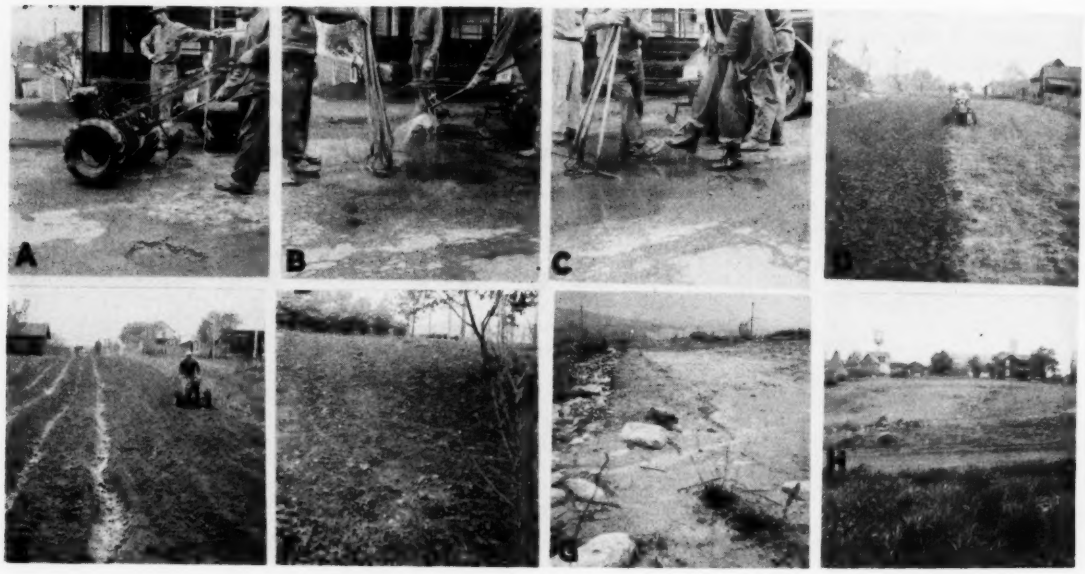


FIGURE 1. A -- Sterilizing a small garden tractor before proceeding to the next garden. B -- Sterilizing hand tools used in planting potatoes. C -- Sterilizing workmen's footwear after planting a garden. D -- Plowing a garden for planting. E-- Furrowing, fertilizing, liming, and planting Russet Rural potatoes. The story of this garden to date is as follows: 1949--Garden was cleared and plowed, berm was totally destroyed. 1950--Wart Immune Irish Cobblers were grown, harvested and garden given standard treatment in the fall. 1951--Garden was plowed, fertilized, limed, and wart susceptible Russet Rural potatoes planted. Susceptible potatoes will be planted three more years -- a total of four years. F -- A treated garden just planted with wart susceptible Russet Rural potatoes -- same schedule as with garden shown in Figure 1, E. G-H -- Two views showing lack of plant growth on garden areas totally destroyed with copper sulfate about four years before. Lack of rainfall resulted in a high concentration of copper sulfate for some time and a thorough job of eradication.

The importance of destroying growth on infested areas that are in sod was vividly illustrated. The owners maintained that the areas were in permanent sod and would never be disturbed. Nevertheless, in several cases cess pools were dug in the sod areas and the dirt scattered. In another case a drainage ditch was dug through the infested area. In still other cases new building was done or additions were made to old buildings, possibly after a change in ownership, thus disturbing the sodded areas that "would never be touched". In Pennsylvania the disturbed soil is sterilized with formaldehyde before it is removed from the infested area.

DIVISION OF MYCOLOGY AND DISEASE SURVEY

[1] A report on the wart program by Dr. Hartman appeared in the June 15, 1951, issue of The Plant Disease Reporter (p. 268).

A 2, 4-D CHEMICAL CAUSES UNUSUAL INJURY TO CABBAGE

Warren N. Stoner

On March 5, 1950, Mr. H. L. Speer, Assistant County Agent, received a report of a peculiar galling of cabbage stems on the farm of Mr. F. W. Cross, Jr., four miles north of Belle Glade, Florida. Specimens were brought to the Everglades Experiment Station for determination.

Microscopic examination of these specimens did not show any visible organism. Cultures of surface sterilized gall tissue also failed to produce any growth.

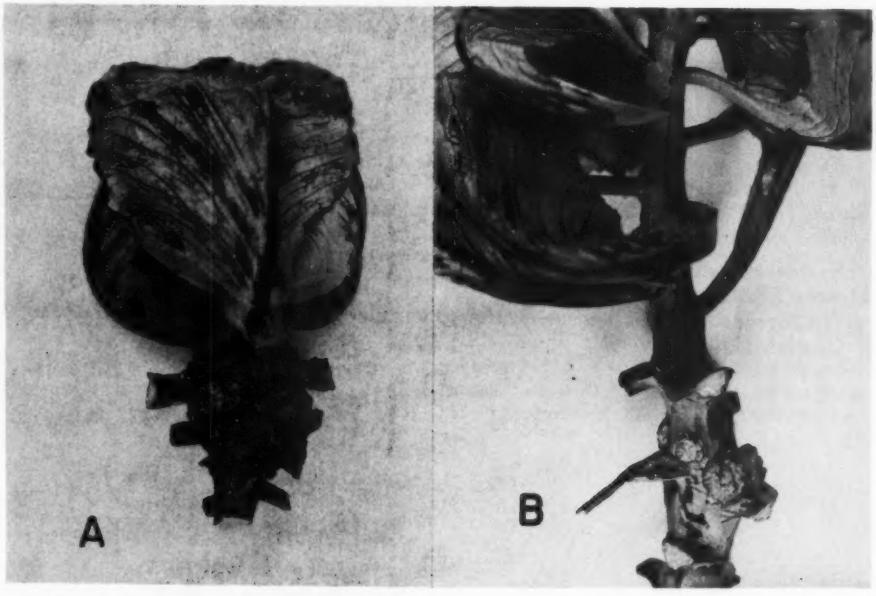


FIGURE 1. Older plant A x 3/16. Note coalescence of galls and envelopment of entire stem. Younger plant B x 3/4. Note development of galls at corners of abscission layers of foliage leaves where separation starts. These plants failed to develop heads. The stems continued to elongate and the leaves became malformed and twisted as in the figure. Both plants are the variety Red Acre.

A close examination of the affected fields on March 17, 1950, proved the condition to be more severe on the older heading plantings and on the west side of the fields, with occasional plants affected throughout the fields. More specimens were taken, and again laboratory findings failed to indicate a visible organism present.

Two more observations were made of the fields at three-day intervals and the condition seemed to be spreading to the east and north at the rate of about 60 feet a day. Subsequent observations showed that the condition had stabilized and no further apparent spread occurred after March 27, 1950. By this date the next adjacent field north of the one first reported was showing the same kind of stem galling. This field was much younger and the plants had not started to head.

The cabbage fields were comparatively free of weeds and the ditch banks were grassed. It was noted, however, that some weed species were showing a slight twisting and curling of the leaves. Upon inquiry it was found that the main drainage canal on the west side of the fields had been sprayed with a 2, 4-D alkanol amine salt for control of water hyacinth about six days prior to the first report of the condition. This material was applied at the rate of one and one-half quarts per 100 gallons of finished spray at a maximum pressure of 30 pounds per square inch in sufficient amount to thoroughly cover the dense growth of hyacinths covering the canal. There were moderate winds from the west at the time of application. Precautions were taken to prevent drift. However, the damage to the cabbage plantings is believed to be directly traceable to this spraying operation.

Because of the two ages of the plantings the injury was expressed differently. The older plants which had headed developed rather large tumors at the abscission layer of the foliage leaves on the stem. Whenever an opening occurred the galls continued to enlarge and eventually coalesced entirely surrounding the stem. (Plant A., Fig. 1). Where leaves did not absciss no galls were noted. Because the heads of the older plants were formed prior to the canal spray operation most of these plants continued in their development and made fairly normal size and yields.

The younger plants were grossly affected in the same manner as the older ones except the galls did not become so large. Instead of producing heads these plants continued to elongate and eventually leaf malformation and twisting occurred (Plant B., Fig. 1). A few did make heads, but they were loose and pointed instead of round.

Both white and red varieties were affected in the same way at the respective ages.

EVERGLADES EXPERIMENT STATION, BELLE GLADE, FLORIDA

TOMATO ROT DUE TO A STRAIN OF GLOMERELLA CINGULATA [1]

George Swank, Jr.

In August 1949, a green Stokesdale tomato fruit having a large diseased area was observed in the tomato plots at Ohio State University. The diseased tomato fruit was brought into the laboratory where single conidial isolations were made. These isolates were designated as 49-S_2-a-1 through 9.

The lesion from which the conidia were isolated was a large black area that resulted from the coalescing of many small lesions. An abundance of acervuli and setae were present in the lesion. (Fig. 1)

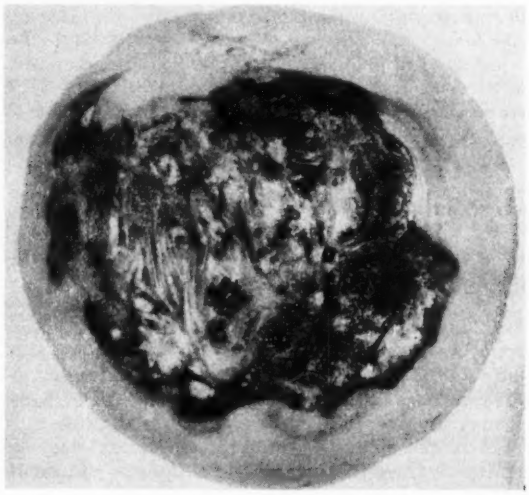


FIGURE 1. A green tomato fruit of Stokesdale variety from which conidia were isolated. Perithecia, asci, and ascospores of Glomerella cingulata developed in culture. Note the coalescence of lesions, and the abundance of small acervuli. Photograph by Department of Photography, Ohio State University.

The isolates were cultured on potato dextrose agar in 125 cc. Erlenmeyer flasks. The cultures formed light gray aerial mycelium (white when young) with irregular peripheries, acervuli in older portion of colony, and abundant small black bodies. The black bodies were perithecia, containing asci and ascospores. Single ascospores isolated from asci produced mycelia from which perithecia, asci and ascospores developed in culture. They closely resembled those of Glomerella cingulata (Stonem.) Spauld. & Schrenk.

The pathogenicity of the isolates was compared with that of a stock culture of G. cingulata. Tomato and apple fruits were inoculated with spore suspensions from respective isolates. The G. cingulata isolate caused lesions on apple fruits but was pathogenic to tomato fruits. The results of inoculating tomato and apple fruits are presented in Table 1.

Table 1. Pathogenicity of isolate 49-S_2-a-1 and a stock culture of Glomerella cingulata on Jonathan apple fruits and Rutgers tomato fruits.

	Apple		Tomato	
Isolate	Number of inoculations	Number of lesions	Number of inoculations	Number of lesions
49-S_2-a-1	15	0	30	26
G. cingulata	15	15	15	15

This strain appears to differ only in pathogenicity from Glomerella cingulata and therefore I have concluded that it is a strain of the bitter rot organism. Further work on this strain is in progress.

CENTRAL FLORIDA EXPERIMENT STATION, SANFORD, FLORIDA

[1] Extract of portion of thesis, "Variation of monosporous isolates of Colletotrichum phomoides", submitted by the writer in partial fulfillment of the requirements for the Degree of Doctor of Philosophy, Ohio State University.

ALTERNARIA LEAF SPOT AND DIEBACK OF SNAP BEAN: A NEW DISEASE IN CENTRAL FLORIDA

George Swank, Jr.

During the spring of 1951 several fields planted to snap beans (Phaseolus vulgaris L.) were infected with a species of Alternaria. No other report, to the writer's knowledge, has been made of an Alternaria species on snap bean in the United States. A report by Neergaard [1] lists Alternaria brassicae f. phaseoli Brun as occurring in Denmark in 1894. However, only the spore measurements are given and they seem to deviate considerably from the one observed in central Florida.

The distribution of the fungus is limited to the Sanford-Zellwood area. These two locations are 26 miles apart.

The loss inflicted on the growers by this organism during the past year was of considerable concern. A second picking was not economically feasible in several of the infected fields. The total acreage planted to snap beans in central Florida is approximately 2000. The number of acres destroyed or infected with this species of Alternaria was estimated to be 100.

A factor which may have influenced the severity of the disease was the heavy infestation of the bean leaf thrip. This factor could result in punctures which would provide an entrance for the Alternaria organism. However, when laboratory inoculations were made, the Alternaria sp., alone, was capable of producing the symptoms.

This is a preliminary report on the symptoms, pathogenicity, and morphology of the fungus involved.

Symptoms

Leaves: -- The symptoms first appear on the leaflets as small, irregular flecks, reddish brown in color with a dark brown or black border. As they increase in size they become circular with concentric zones within the area affected (Figure 1). The center of the lesion becomes light brown. The older portion of the lesion may fall out, leaving a shot hole appearance (Fig. 2). The size of the lesions varies but may involve an area of 1.5 cm. in diameter. Lesions often coalesce to form large areas of dead tissue. Other symptoms on leaves may appear as individual leaflets dying back from the tip or from the margin. The fungus continues to spread until the entire leaf is killed. The fungus also invades the leaflet at the edge and moves across the leaf to the midrib. The other side of the leaflet may remain healthy during the death of the infected side (Fig. 1). The central growing point of the plant is often killed, its death remaining unnoticed until the surrounding foliage is pulled back and the examination made.

FIGURE 1. Snap bean (Phaseolus vulgaris (L.) infected with Alternaria sp. Note the pattern of the lesions, the dieback of the leaves, and the infection of one side of the leaflet.

[1] Neergaard, Paul. Danish Species of Alternaria and Stemphylium. Humphrey Millford, Oxford Univ. Press., London. 1945.

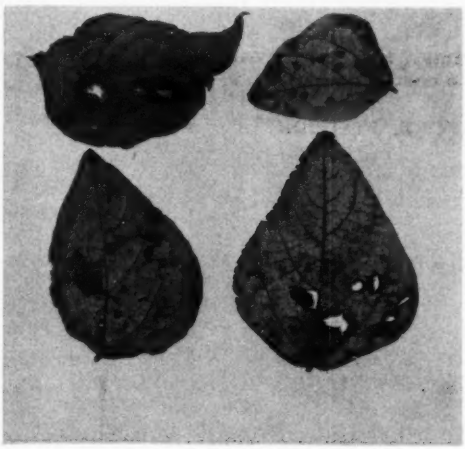


FIGURE 2. Leaflets of snap bean, illustrating the lesions and shot hole appearance.

Stems and Petioles: -- The lesions on the stems and petioles appear as breaks in the epidermis and are bordered by a dark brown or black margin. As the lesions enlarge, the center part becomes light brown in color.

Peduncle: -- The lesions on the peduncle are similar to those occurring on the stems and petioles. Many pods and flowers abscise as the result of the peduncle infection.

Pods: -- No lesions have been observed on the pods in the field. Inoculations of the pods in the laboratory did not result in any lesions being formed.

Pathogenicity

Isolation: -- Stems and leaves having symptoms of the disease were brought into the laboratory for culture work. The tissue fragment culture method was used. The diseased tissue was surface-sterilized in bichloride of mercury 1-1000 and rinsed in three changes of sterile water. The fragments were then plated on 2% potato dextrose agar. The isolation of an Alternaria sp. occurred with regularity. The fungus was transferred to potato dextrose agar slants for further studies.

Inoculation - Reisolation: -- The fungus was grown on potato dextrose agar for a period of ten days. Sterile tap water was then added to the cultures in preparation of a spore suspension. The surface of the fungus growth was rubbed lightly to remove the spores. The spore suspension was atomized on four-week-old snap bean plants with a hand atomizer. The inoculated plants along with check plants were placed in a moist chamber for a period of 48 hours. The plants were removed from the moist chamber and placed on an open air bench at the end of this period. Small flecks were noticeable on the leaves of the inoculated plants at the end of three days. The lesions developed slowly. The central growing tip, i. e. the leaf, was killed in five days. These symptoms were identical with those observed in the field.

Reisolation of the fungus by the tissue fragment method confirmed the pathogenicity of the species.

Causal Organism

The causal organism belongs to the genus Alternaria. An attempt has not been made to key the organism out to the species. However, a certain amount of morphological study was made. This species appears to differ from the one described by Brun, who gave the measurements of the conidia as 60 x 62 x 15 microns.

Description: Cultural characters. On potato dextrose agar the mycelium is aerial, cottony and dark grey in color. The conidiophores are light brown, septate, erect, with conidia appearing singly or in chains. The conidia are more or less oval, tapering toward the beak, light brown or buff brown. The spore body is 28.7-80.2 x 12.3-20.5 microns with 4 - 7 transversal septa and 0-3 longitudinal septa. The beak is 20.5-73.8 microns long with 0-4 transversal septa. The total length of the spores is 49.2-154 x 12.3-20.5 microns.

Control

No control measures are known at the present time. However, it can be assumed that the control measures for other Alternaria sp. would also control this species.

CENTRAL FLORIDA EXPERIMENT STATION, SANFORD, FLORIDA

ALTERNARIA LEAF SPOT OF GLADIOLUS

S. A. Simmons

A leaf spot of gladiolus was observed in a plantation in Ontario during July, 1949. The disease incidence was sufficiently high to cause the grower serious concern.

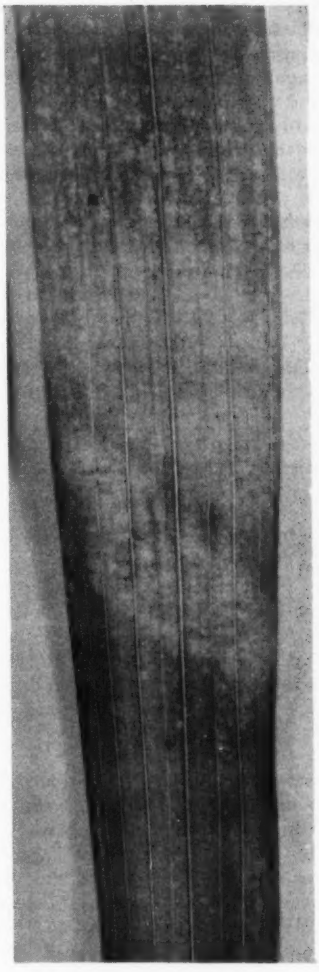


FIGURE 1. Early symptoms of Alternaria leaf spot on gladiolus.

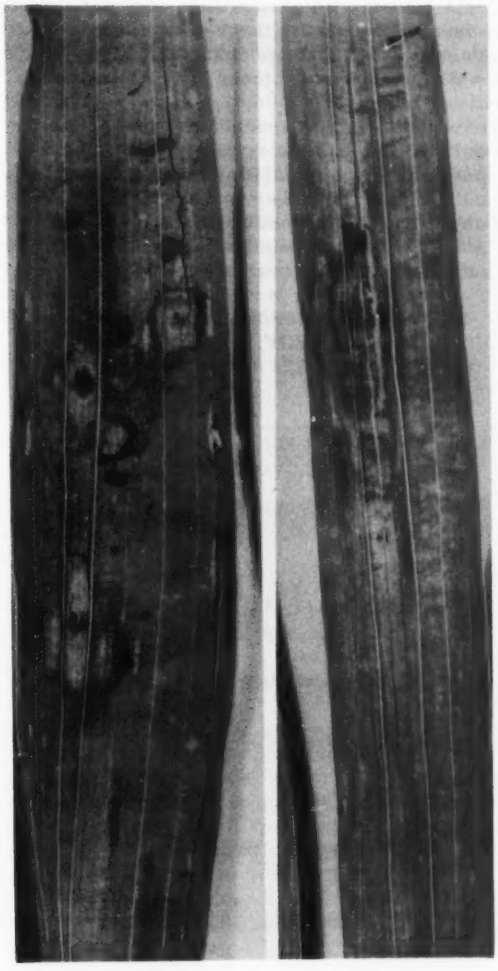


FIGURE 2. Later stage of Alternaria leaf spot on gladiolus.

Typical symptoms are illustrated in Figures 1 and 2. A diffuse blanching of a large area of the leaf appears first with a rusty brownish flecking in the blanched area. The blanching distinguishes the lesions rather sharply from any other leaf spot of gladiolus known to the writer, especially Curvularia. The blanching persists, even after sporulation, and extends beyond the necrotic spot. The spots vary in size from 1/8 inch to 1 inch or more in length. The centres are frequently light tan colored but eventually become quite dark over a considerable portion because of the spore masses produced (Fig. 2). The entire centre of the lesion frequently shreds and drops out. The lesions may involve the full width of the leaf, in which case the distal portion of the leaf soon yellows, turns brown and dies. Even at this late stage the blanching of the leaf sets off many of the lesions in striking fashion and extends as far beyond the lesion margin as the width of the lesion itself. The brown border is not nearly as clear cut as in

Botrytis leaf spot and frequently merges gradually outward into the blanched portion.

Isolates from lesions were identified as Alternaria fasciculata Cke. & Ell. and this identification was confirmed by Dr. J. W. Groves, Department of Plant Pathology, Division of Botany, Ottawa.

Pathogenicity of the organism was established by inoculation. Portions of diseased leaves, bearing characteristic lesions, were attached to healthy leaves of gladiolus plants growing in a greenhouse bench. The plants were enclosed in moist chambers and, 10 to 14 days later, typical lesions developed opposite those on the attached portions of diseased leaves. Typical lesions also developed when slabs of agar bearing growths of the organism were attached to healthy leaves which were then enclosed in cellophane bags. Sterile agar slabs, used as checks, had no effect on the leaves.

It is well known that species of Alternaria vary considerably in parasitic capability. Because the severity of this particular outbreak was such as to prompt the grower to ask for assistance in its control it is worth pointing out that species of Alternaria found commonly on the gladiolus, and usually dismissed rather casually, may on occasion cause considerable damage.

In any case the evidence in this instance points to the fact that Alternaria fasciculata is capable of parasitizing healthy gladiolus leaf tissue and under suitable environmental conditions may develop to epiphytotic proportions.

G. & C. MERRIAM COMPANY, SPRINGFIELD, MASSACHUSETTS. FORMERLY ONTARIO AGRICULTURAL COLLEGE, GUELPH, CANADA

SOME NEW RECORDS OF PLANT DISEASES

A NEW STEM RUST ON VIRGINIA PINE

By George H. Hepting

In April 1948, W. A. Stegall[1] collected a fruiting specimen of caulicolous Peridermium on Pinus virginiana west of Waynesville, North Carolina. The rust was distinct from any known form on this species because of a lack of deformation and little or no swelling at the canker, the columnar mostly non-confluent aecia, lack of intrasoral filaments, and unusually long, narrow aeciospores.

Subsequent collections have been made in Wythe, Alleghany, Montgomery, and Pulaski Counties, Virginia; in Morgan and Unicoi Counties, Tennessee; in Greenbrier County, West Virginia; and in Mitchell County, North Carolina. All cankers found to date have originated since 1936. The action of the rust is similar to that of white pine blister rust, but killing is slower.

No pycnial stage has been observed, and no alternate host yet found. A technical description of the fungus and further information on its pathogenicity, under authorship of George H. Hepting and George B. Cummins, will appear later in Phytopathology. In the meantime, we solicit reports of this rust. Aecia in good condition have been observed from April to August. This fungus could prove serious if it is a recent introduction. The susceptibility of our other hard pines to it is not known.

DIVISION OF FOREST PATHOLOGY, BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING, ASHEVILLE, NORTH CAROLINA

[1]Division of Blister Rust Control, Bureau of Entomology and Plant Quarantine. Henry E. Yost of this Division has been most helpful in locating subsequent infections.

CARICA PAPAYA, ANOTHER POSSIBLE HOST OF PHYTOPHTHORA CINNAMOMI

By C. Bazán de Segura

For some years the death of avocado trees (Persea americana) has been observed in the Chanchamayo Valley of Peru, and it is estimated that to date more than 50,000 trees have disappeared. It has finally been possible to isolate from the roots of diseased trees the fungus Phytophthora cinnamomi, a possible agent of the disease which has caused so much damage in the area in question.

In a recent trip to Chanchamayo many plants of papaya (Carica papaya) were observed dying. The disease was characterized by the drying and progressive fall of the leaves, with the result that the plants were finally completely defoliated and death ensued. The fungus, P. cinnamomi, was isolated from a high percentage of the roots of diseased plants brought back to the phytopathological laboratory of the "Centro Nacional de Investigación y Experimentación Agricola de La Molina." It is furthermore noted that in the Chanchamayo area the agriculturists recognize that the loss of many plantings of papaya has occurred in areas where the avocado disease was observed. It is therefore, very possible that the fungus, P. cinnamomi also attacks the papaya.

CENTRO NACIONAL DE INVESTIGACION Y EXPERIMENTACION AGRICOLA DE LA MOLINA

BRIEF NOTES ON PLANT DISEASES AND A CORRECTION

BLACK PATCH OF RED CLOVER IN WEST VIRGINIA

By J. G. Leach and E. S. Elliott

The Department of Plant Pathology and Bacteriology have, for the past two years, made a study of the causes of red clover failure in the northeastern section of West Virginia. In this region, especially in the South Branch Valley of the Potomac, red clover is an important forage crop and many farmers have been growing the crop for seed. In recent years there have been many red clover failures for which there were no satisfactory explanations. In some cases there have been poor stands and in others, the seed yields have been poor in spite of good stands.

The study under way has shown that there are many diseases and insects which contribute to clover failure, but most of the trouble has been caused by a relatively new fungus disease,

about which very little was known. This disease, called "black patch," was first observed in Kentucky in 1933 where it was considered to be of minor importance and was not studied extensively. Four years later, it was observed in Wisconsin where it was reported as a minor disease that could affect only the leaves, causing little injury. In the South Branch Valley in West Virginia, the disease has been found to be very destructive, affecting all parts of the plant, including the leaves, stems, and flowers. By destroying the flowers, this disease has been responsible for great reductions in seed yield in fields that have excellent stands.

Black patch is caused by a fungus, which unlike most fungi, produces no spores. Since no spores are produced to be blown around by wind, the method of spread was not known. The West Virginia studies have shown that the fungus infects the seeds and is seed-transmitted. When infected seeds are planted, the seedlings will be killed and the fungus will spread from these infected seedlings to adjacent plants by means of aerial mycelium. One diseased seedling from an infected seed may result in a patch of black diseased plants from which the descriptive name, "black patch," is derived.

The disease appears to be very prevalent in the eastern part of the State, but has not been found to cause appreciable injury east of the Appalachian Mountains. The disease is obviously favored by wet weather, but in the mountain valleys heavy dews are common even in relatively dry weather, a factor which may account for its more severe injury in such regions.

Preliminary greenhouse experiments show that seed treatment will decrease seedling infection and increase stands, but further experiments under field conditions will be necessary before any recommendations for control can be made.

WEST VIRGINIA UNIVERSITY, MORGANTOWN

OBSERVATIONS ON CUCUMBER ANTHRACNOSE IN LOUISIANA

By J. G. Atkins, Jr.

In 1950 anthracnose, Colletotrichum lagenarium, was a very minor foliage disease on the fall cucumber crop in Louisiana, as would be expected in a season of very limited rainfall. At the Fruit and Truck Experiment Station, Hammond, Louisiana, a number of fungicides have been evaluated in field tests each year for the control of downy mildew, the most important and ever-present foliage disease, and anthracnose, a rather sporadic but often very destructive disease. In some of the tests, as in 1950, the incidence of anthracnose was so low that the various fungicides could not be adequately evaluated for the control of this disease. Observations indicate that anthracnose first appears in one or more small spots or areas in a field but does not become generally distributed and epiphytotic unless favored by weather conditions. Most of the cucumbers in Tangipahoa Parish, the principal area for the fall crop, are irrigated when necessary and frequent heavy dews provide adequate moisture for the anthracnose fungus to produce conidia on infected leaves for dissemination by physical means, chiefly wind-blown rain.

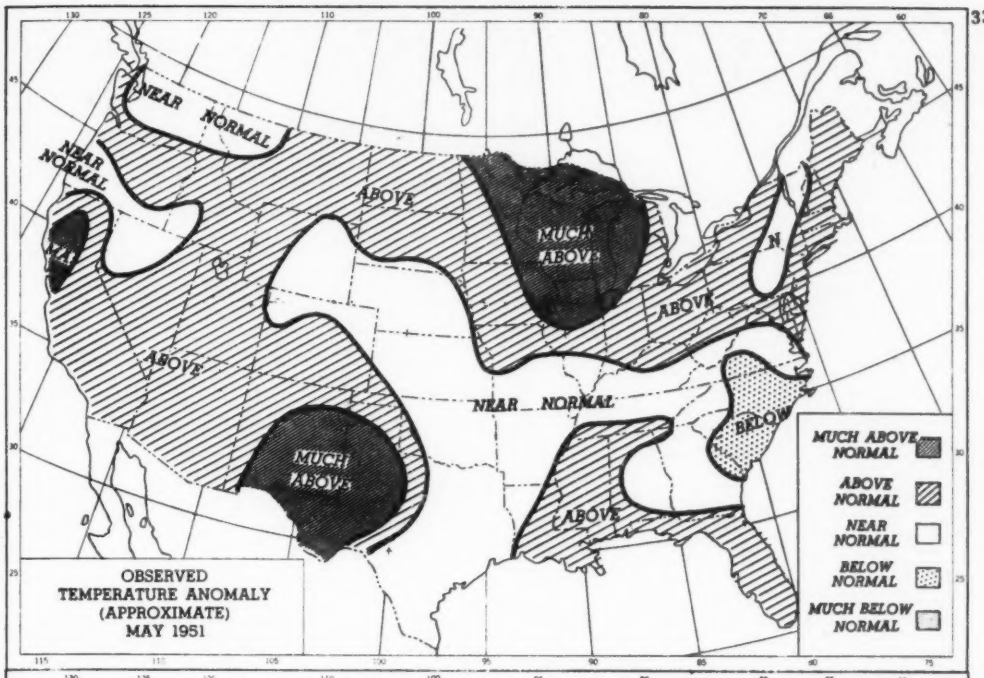
Frequent heavy rains along with tropical storms were favorable for the development of anthracnose in 1947 and 1949. Such conditions were also rather unfavorable for controlling the disease with fungicides. In 1948 anthracnose was generally distributed over the experimental test plots as well as commercial fields following a period of rainy weather, September 10-14. Although anthracnose was expected to become severe, a period of relatively dry weather followed and there was little further development of the disease. Anthracnose was very light in 1950 owing to very limited rainfall during September and October.

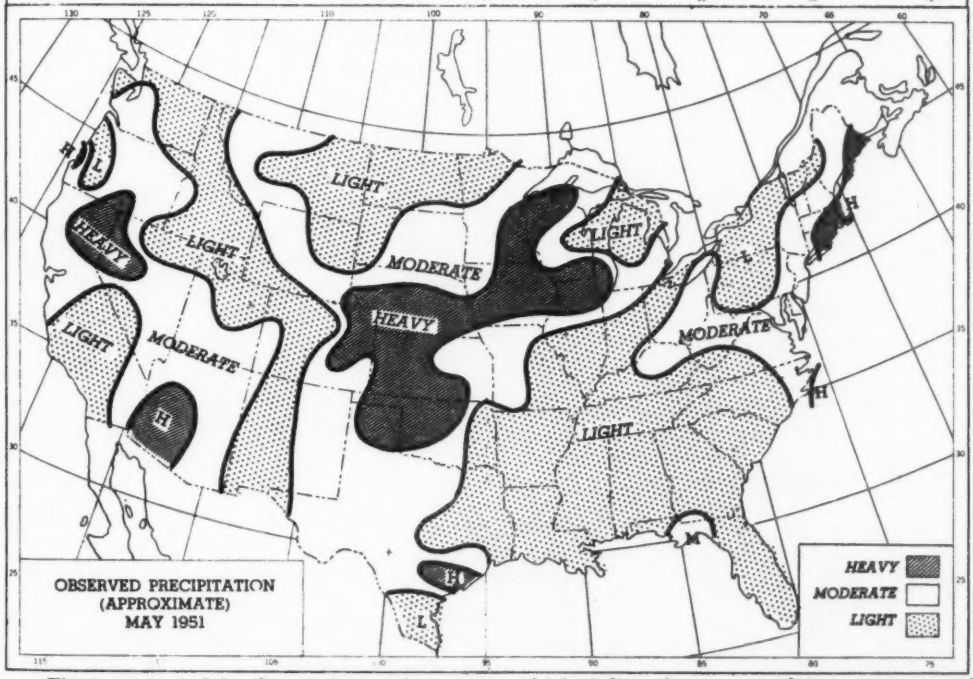
The results of the National Cucurbit Fungicide Trials summarized in the Plant Disease Reporter for the past several years indicate that anthracnose has not caused appreciable damage to cucumbers in States other than Louisiana. However, in Louisiana, the disease has been rather sporadic. This sporadic behavior and destructiveness of anthracnose parallels weather conditions favorable for the dissemination of the fungus. Conditions prevailing during tropical Gulf storms are probably ideal for the spread of anthracnose.

DEPARTMENT OF PLANT PATHOLOGY, LOUISIANA AGRICULTURAL EXPERIMENT STATION, BATON ROUGE

A CORRECTION

Our attention has been called to an error in the paper on "Potato Wart In America" by R. E. Hartman, in the June issue of the Reporter. On page 268, the third line from the bottom should read ".....40% formaldehyde applied at the rate of 20 gallons per 100 square feet .....", not 20 gallons per square foot as given.





The terms used in the accompanying maps, which define the ranges of temperature and precipitation, are numerical class limits. These are based on a statistical analysis of past records through which is determined the normal frequency of occurrence of temperatures and precipitation at various times of the year for different locations. For temperature the classes above, below, and near normal are so defined that they each normally occur one-fourth of the time; much above and much below normal, one-eighth of the time. Precipitation is depicted in terms of light, moderate, and heavy, each class normally occurring one-third of the time and thereby having equal probability of occurrence. These maps graphically represent only the general trends and give the country's weather picture at a glance. For quantitative studies, where monthly mean temperatures and actual precipitation records are needed for a given time and place, other publications of the Weather Bureau should be consulted. P. R. M.

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